BEYOND THE PALISADE:

A GEOPHYSICAL AND ARCHAEOLOGICAL INVESTIGATION

OF THE 3RD TERRACE AT ANGEL MOUNDS STATE HISTORIC SITE

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Submitted to the faculty of the University Graduate School
in partial fulfillment of the requirements
for the degree
Master of Arts
in the Department of Anthropology,
Indiana University

December 2012

Accepted by the Faculty of Indiana University, in partial fulfillment of the requirements for the degree of Master of Arts.

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ACKNOWLEDGEMENTS

Thanks first and foremost to my wife, Abra, for living the dream with me; to my family for keeping me going; to Jeremy Wilson and everyone at IUPUI and Bill Monaghan and Tim Baumann at the Glenn Black Lab for providing me with the opportunity, resources, and guidance to complete this project; to the GBL for trusting me with the mag and turning me loose with it; and to all the field school students who spent the summer moving my lines 25 cm at a time.

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Chapter One - Introduction

> "Much of the difficulty in acquiring regional-scale data may be attributed to the retention of two related elements in the traditional fieldwork legacy: (1) the notion of *site* and (2) the excavation technique of data acquisition...... Consequently, there is a tendency to think of the sampling universe as a set of sites rather than a bounded unit of space."
>
> (Dunnell and Dancy 1983:268)

Unfortunately, the same issues that Robert Dunnell and William Dancy identified in their 1983 article in *Advances in Archaeological Method and Theory* (Schiffer 1983) still persist in archaeology today. While excavation strategies have progressed in the almost 30 years since this publication and there have been regional-scale analyses performed in many areas and on varied datasets, including research in the Eastern Woodlands of North America and, more specifically, the Mississippian world (Blitz 1999; Pollack 2004; Blitz and Lorenz 2006; Marrinan and White 2007; Rees and Livingood 2007; Rafferty and Peacock 2008), the concept of bounded sites and traditional excavation practices persist in many research projects. Traditional excavation techniques remain the workhorse of archaeological research for a very good reason. There are certain data, relationships and phenomena that can only be learned from a careful assessment of the stratigraphic layers of an excavation block and this study is not meant to deny this important practice. However, new technologies, techniques, and a reevaluation of old techniques and excavations have much to offer the field of archaeological research, though frequently remain secondary to excavation. Not only do these newer and rethought techniques have information to contribute to the archaeological record, they are providing newer and innovative ways of thinking about archaeological sites (Johnson 2006; Perttula, et al. 2008; Peterson 2010; Krus and

Marshall 2011). Therefore, there remains abundant potential for broader analyses of archaeological landscapes. Many analyses have been completed and changed the way we think about past peoples' interactions with their surrounding environment (e.g., Smith 1978), but many have yet to be started as well.

This study, conducted during the summer field season of 2011, the school year of 2011/2012, and the summer field season of 2012, is an illustration of the efficacy and efficiency of geophysical remote sensing methods paired with a minimally invasive shovel test survey and the analysis of legacy collections to conduct a landscape survey of the areas surrounding the Mississippian site of Angel Mounds (12Vg1). The geophysical survey, completed during Indiana University and the Glenn A. Black Laboratory of Archaeology's archaeological field schools in 2011 and 2012, focused on the landscape immediately adjacent to the palisaded Mississippian site of Angel Mounds. It attempted to identify cultural modification of the landscape outside the palisade walls at Angel Mounds. While the time period of the Mississippian occupation of Angel Mounds was the main focus of the survey, identifying historic Euro-American, as well as Woodland period Native American modification of the landscape was also a goal of the project. Not only is information about the effect on the landscape during these time periods important in its own right, but also potentially has bearing upon the cultural features that may be evident from Angel Mounds' Mississippian occupation.

A targeted shovel test of portions of the landscape is also a minimally invasive method that provides additional information that the geophysical survey did not yield. Artifact densities and distributions add a great deal of information to geophysical anomalies that are present across the landscape. In addition, soil profiles and descriptions provide a baseline for interpretation of geophysical results, identifying cultural features and correlating these features with geophysical anomalies. Similarly conducted during the archaeological field schools at Angel Mounds in 2011 and 2012, the shovel test survey served both of these functions, increasing the potential for interpretation of the landscape beyond that of just the geophysical remote sensing survey. A more traditional survey methodology, shovel test surveys remain an essential part of the archaeological toolkit despite advances in remote sensing methods.

Meanwhile, legacy collections remain an underutilized resource in archaeological research today. At Angel Mounds, a large portion of material that was excavated during the era of Works Project Administration (WPA) archaeology in the late 1930's until World War II remains largely unanalyzed (Baumann, et al. 2011). Although the collection is in a more stable condition than other legacy collections, the potential information that is contained within it remains locked away. There is only a general count of all artifact types conducted throughout the era of early excavation and compiled by James Kellar after the death of Glenn Black in 1964 (Kellar 1967). This, combined with the relatively detailed (for his time) excavation notes and plan maps created by Black, allow for a greater depth of investigation into these legacy collections today. One relatively small portion of the collection from Angel Mounds comes from an area outside the known extent of the palisade wall and is located on a river terrace above the main site – the 3rd Terrace. The analysis of this portion of the Angel Mounds collection has shed some light on potential occupations and activity patterns that fall outside of the palisade wall, where excavations tend to cease at Mississippian period sites.

Based on these three avenues of investigation – near surface geophysical survey, shovel test survey, and legacy collection analysis – the beginning of a landscape survey of the suburbs and hinterlands of Angel Mounds has effectively been undertaken. Because the broad scope of a landscape analysis is often too large to be adequately investigated by block excavation strategies alone, this suite of methods is well suited to answer questions surrounding the distribution of cultural activities and modification across a landscape. With this approach, I have begun to investigate the wide sphere of interaction that Mississippian people at Angel must have had within their landscape and during their daily lives. While there has been work done on many sites in the area that likely have direct ties to Angel Mounds, my work begins to connect some of the dots by considering the areas between sites, beginning with Angel Mounds' backdoor.

In Chapter Two, I will provide a brief history of Angel Mounds State Historic Site as an archaeological site, including the scale and focus of research at the site from the beginning of the 19th century up to the present day. In Chapter Three, I lay out my research goals, including the research plan for geophysical and shovel test surveys of the 3rd Terrace, as well as a reanalysis of the 1939 3rd Terrace legacy collection. Chapter Four is a more detailed discussion of the 3rd Terrace, both in terms of a Mississippian cultural presence on the landscape as well as initial archaeological investigations there. Both of these are important in the creation of the current 3rd Terrace legacy collection. Chapter Five is a review of magnetometry as a technology and as an archaeological investigative method, and discusses the utilization of magnetometry at Angel Mounds and throughout the wider Mississippian archaeological community. Chapter Six is a discussion of specifics materials and methodologies that have been incorporated and utilized in the current research. This discussion includes the geophysical and shovel test surveys, data processing, and analytical methods for the 3rd Terrace legacy collection. In Chapter Seven I present the results of all three research methodologies, including the final magnetometry survey map, shovel test survey, statistical analysis of the 3rd Terrace ceramics, and results of a ^{14}C date obtained from the 3rd Terrace. Chapter Eight provides a final synthesis of the significance of the results of the various research methodologies, and places the research in context with each other and within broader research conducted at Angel Mounds.

Chapter Two - A History of Angel Mounds

A History of Angel Mounds as an Archaeological Site

Angel Mounds (12Vg1), located southeast of modern-day Evansville, Indiana on the north bank of the Ohio River, has been a figurehead of Indiana archaeology since its acquisition by the Indiana Historical Society in 1938. A premier Mississippian center in the region (Black 1967; Hilgeman 2000; Monaghan and Peebles 2010; Peterson 2010; Baumann, et al. 2011; Krus and Marshall 2011; Krus, et al. 2012), it is in a unique position of protection because of its long history of State ownership. The site is currently under the administration of the Indiana Department of Natural Resources and is operated as a State Historic Site with a museum and interpretive center. The first records of the site that were written by Euro-Americans were that of a land survey crew in 1805. Jacob Fowler recorded in his notes a "Mount 70 links [46 feet, 2 inches] to the north of line about 25 feet high – About 3 Chains [198 feet] in Diameter" (Fowler 1805:149) that corresponds with the location of what is now referred to as Mound G (Black 1967). Although this earthwork is not part of the main mound group at Angel Mounds (it retains its own site number – 12W54, residing in Warrick County, Indiana) and is likely of a much earlier Woodland period origin, Mound G is typically included as part of the site and certainly would have been known to and been within the daily interactive sphere of Mississippian peoples at the site.

Seventy years after this initial survey, in 1875, a geological survey of the county by John Collett describes multiple mounds in the vicinity of the site, although exact placements are erroneous. His description of the material culture associated with the site is also interesting (and perhaps with the surrounding areas as well); it includes "vases, jars, jugs, implement handles, images of duck and owl heads, human faces in pottery; also buttons of cannel coal, and axes, hoes, spades, pestles, grinders, celts, arrow and spear points of stone." He also notes that "Graves of savage Indians are discovered throughout the county, sometimes intruders upon the mounds, but shallow and carelessly made" (Black 1967:6 - from Collett 1876:299-300). This survey also produced the first known map of the site, albeit as a cartographic footnote of a larger county map and fairly inaccurate at that.

Subsequent maps and descriptions of the site include Dr. Floyd Stinson's 1876 observations reported to the Smithsonian Institution and published in their *Annual Report* in 1881, the Indiana *Geological Report* for 1886 by S.S. Gorby, and the first detailed map and additional description by Cyrus Thomas prior to 1890 (see Figure 2.1) (Black 1967 - from Stinson 1883; Gorby 1887; and Thomas 1894). Building upon these is A.H. Purdue's map (see Figure 2.2) and description for

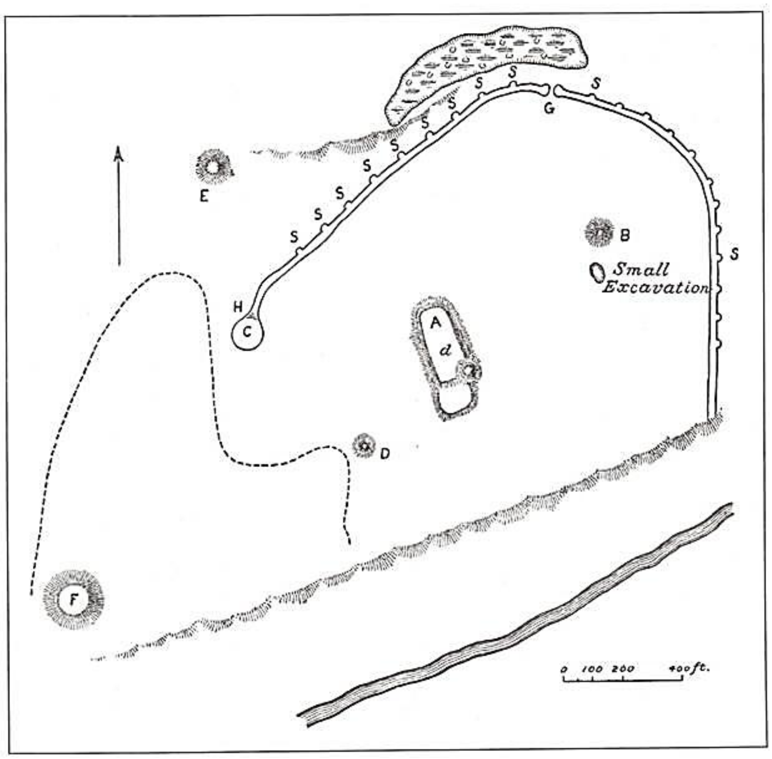

Figure 2.1: 1881 Cyrus Thomas map

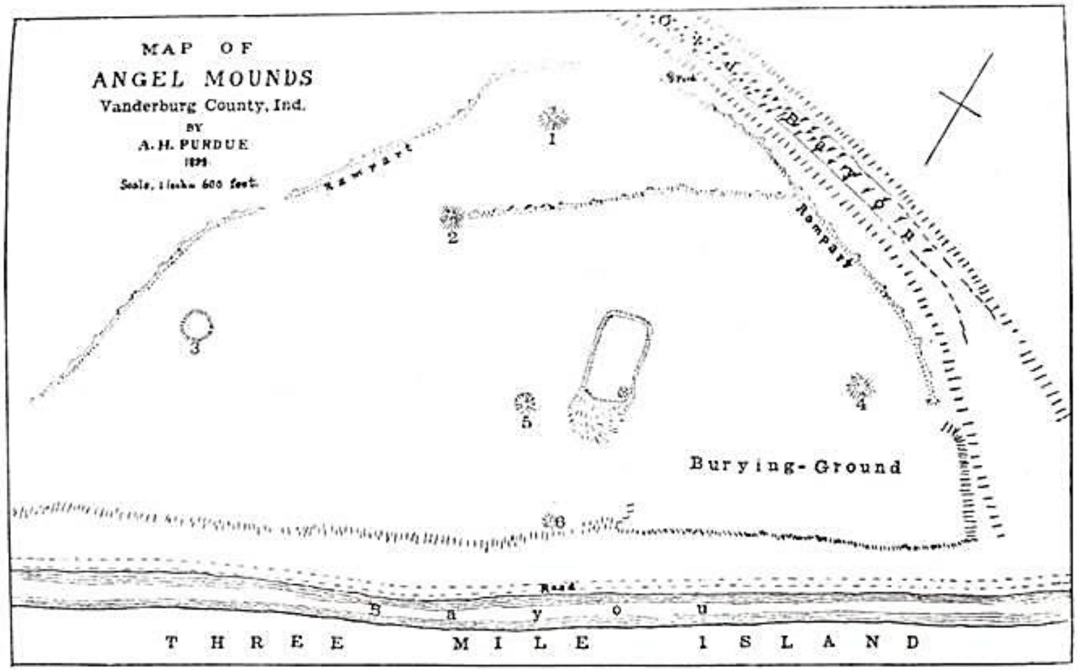

Figure 2.2: 1896 A.H. Purdue Map

the Indiana Academy of Science in 1896, which corrected several earlier inaccuracies. Several avocational relic hunters made reports at meetings of the Southwestern Indiana Historical Society in the early decades of the 20th century (Black 1967). Likewise, Angel Mounds was mentioned in several publications including Henry C. Shetrone's *The Mound Builders* (1930) and Samuel A. Barret's *Ancient Aztalan* (1933). In 1937, the Indiana Historical Society published *Prehistoric Antiquities of Indiana* by Eli Lilly, with additional maps (see Figure 2.3) and a description of the site, foreshadowing the acquisition of the site by the Indiana Historical Society upon the insistence of Lilly the next year. This set the stage for the bulk of archaeological investigations by Glenn A. Black in the years to come.

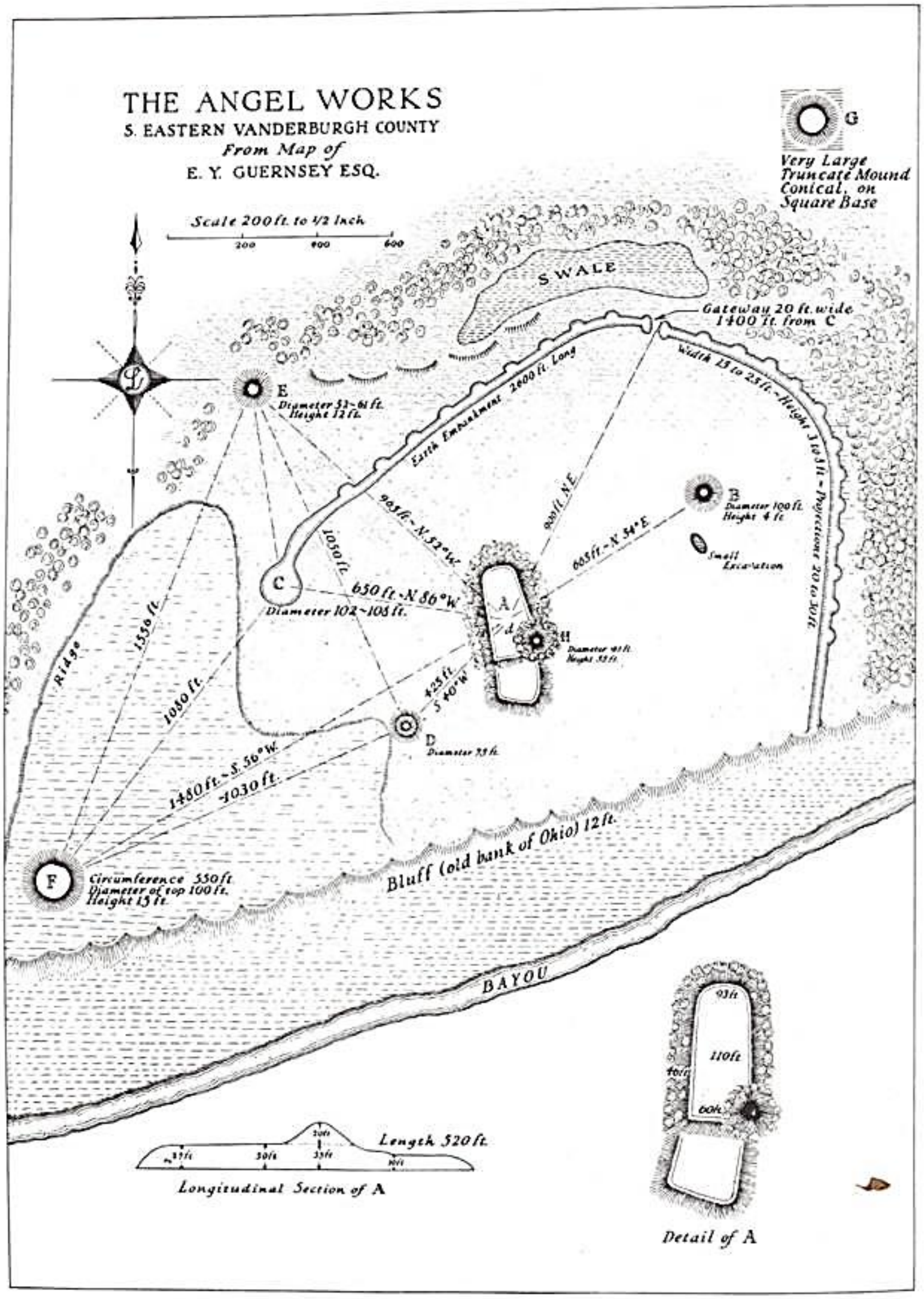

Figure 2.3: 1937 Eli Lilly Map

WPA Era Excavations and Indiana University Field Schools

Previous archaeological excavations at Angel Mounds have focused primarily on the monumental earthworks (specifically Mounds A and F), the East Village, and the palisade walls surrounding the main habitation area. The bulk of these excavations were conducted from early 1939 through the summer of 1942 by workers under the Federal Works Progress Administration (WPA) and were overseen by Glenn A. Black of the Indiana Historical Society. Shortly after the acquisition of the site by the Indiana Historical Society in 1938, a site grid was established based on the original survey of the area by Jacob Fowler in 1805. Excavation commenced the following spring and summer utilizing laborers from the WPA. The initial excavations were used as a training ground for these workers and were conducted on what is now known as the 3^{rd} Terrace. An exercise in soil stratigraphy in the remnants of a Euro-American farmhouse cellar produced unexpected Pre-Contact archaeological materials and served as the basis for the 3^{rd} Terrace excavations. In total, once excavations on the 3^{rd} Terrace were completed, 4,300 square feet (roughly 400 meters squared) had been excavated across five subdivisions of the site grid to an average depth of 2 feet (~0.61 meters) (see Figure 2.4).

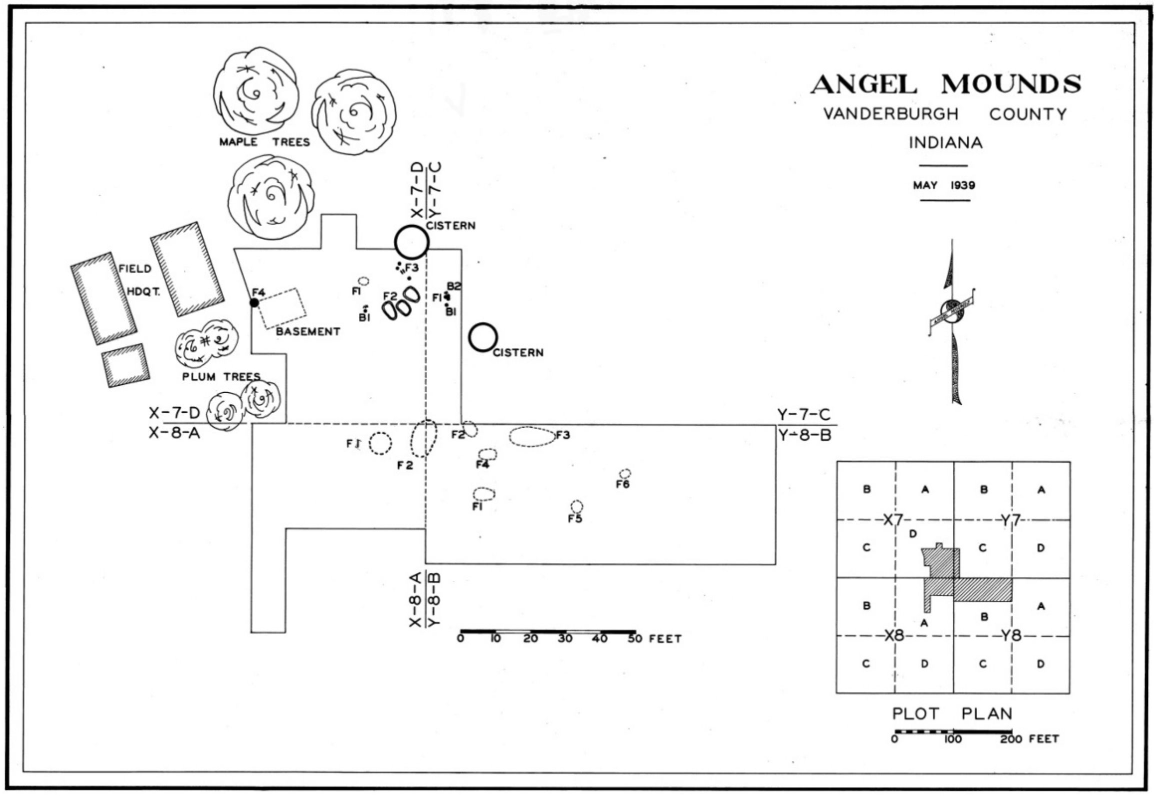

Figure 2.4: Plan view of 1939 3rd Terrace Excavations by Glenn A. Black
From the Glenn A. Black Laboratory of Archaeology Archives

This area produced an assemblage consisting of over 17,500 individual artifacts and three (and possibly as many as five) human burials. Thirteen features were also identified (see Figure 2.4), one of which (F2/X-7-D) was proposed by Black to be of 'Caucasian' origin. The rest of the features mainly consisted of what appear to be pit features with relatively high concentrations of artifacts (Black 1967:85-104). After these initial 'practice' excavations, the expanded WPA crew went on to uncover 119,800 square feet (~11,130 square meters) of the main site, moving an estimated 13,000 cubic yards (~9,939 cubic meters) of earth. These areas encompassed exposed floors containing many structures covering multiple subdivisions, 1,707 lineal feet (~520 meters) of the palisade wall (including eight bastions), and the excavation and processing of 2,379,637 individual artifacts. The bulk of excavations were conducted in the East Village, an area along the eastern edge of the site within the palisade. A dense palimpsest of wall-trench structures and coincident burials characterizes this area. It is interpreted as an area of dense occupation beginning around A.D. 1300 and continuing until the site was abandoned around A.D. 1425/1450 (Monaghan and Peebles 2010; Baumann, et al. 2011; Krus, et al. 2012). Excavations were also conducted upon previously mentioned areas of the palisade wall (including bastions) and on Mound F. Mound F was almost completely removed through excavation, exposing two mound surfaces and a large multi-room structure situated atop a "primary" surface (Black 1967).

From 1945 until 1962, summer field schools were conducted as a partnership between the Indiana Historical Society and Indiana University. Once again, Black directed these investigations (1967). While these were nowhere near the unprecedented scale of the WPA era excavations, a newer and more targeted kind of research was produced. These excavations included test excavations on Mounds A and K, as well as continued work in the East Village and along the palisade in various areas on site. In 1962, the first magnetometry survey on an archaeological site in North America was conducted at Angel Mounds. Directed by Glenn Black and Richard Johnston (1962), the survey utilized a van-mounted magnetometer to record readings of magnetic field strength variation and was able to confirm the utility of the survey method after locating a section of the palisade wall through magnetic survey and subsequent ground-truthing excavation. After Black's death in 1964, research again slowed at the site. The Glenn A. Black Laboratory of Archaeology (GBL) was constructed in honor of Black and to house the Angel Mounds' collection, as well as to conduct further research at the site and across the state. Considerable research, although relatively limited in scope by the WPA era standards, by Indiana University and the GBL has continued at the site. New technologies and focused research questions have recently moved our knowledge of Angel Mounds far past what it once was even a decade ago (Monaghan and Peebles 2010; Peterson 2010; Baumann et al. 2011).

More current research to come from Angel Mounds includes the development of a relative pottery chronology based mainly upon a decorative variety of ceramics known as "Angel Negative Painted" by Sherri Hilgeman for her Ph.D. dissertation, as well as a monograph entitled *Pottery and Chronology at Angel* (Hilgeman 2000). Other dissertations incorporating data from Angel Mounds include Stephen Ball's *The Practical Application of Geophysical Surveys to Prehistoric Sites in Eastern North America* (Ball 1999) and Staffan Peterson's *Townscape Archaeology at Angel Mounds, Indiana: Mississippian Spatiality and Community* (Peterson 2010). Both of these publications explore the continued use of archaeogeophysical survey techniques, with Ball exploring the applicability of a variety of near surface geophysical methods at various sites in Eastern North America and Peterson exploring Mississippian spatiality using a 'Townscape' landscape approach in conjunction with a site-wide magnetic gradiometry survey.

Current work at Angel Mounds centers around anthropogenic transformation of the landscape in and around the site, as well as the development of an absolute chronology based upon an improved and an increased number of radiocarbon dates in conjunction with a better understanding of the stratigraphic relationships of previously excavated features by Black in the East Village. In addition, geophysical investigation and small diameter coring of many of the earthworks on site have produced relative construction chronologies, as well as absolute dates for the construction and use-life stages of several of the mounds, with the largest – Mound A – being completed (Monaghan and Peebles 2010), and additional work at Mounds E, F, G and H ongoing. Combined, these reevaluated chronologies using data from the East Village, many of the mounds, and many of the iterations of the palisade wall have created a much more intricate picture of the developmental chronology of Angel Mounds into which this work can be evaluated.

Chapter Three - Research Plan

The research plan that formed the bulk of the work contributing to this thesis focused on an often-overlooked portion of Angel Mounds – the 3rd Terrace. The 3rd Terrace is a geologically older alluvial landform that sits higher in elevation than the 2nd Terrace upon which Angel Mounds sits. Through a geophysical remote sensing survey utilizing a magnetic gradiometer, a targeted shovel test survey and a reanalysis of the 3rd Terrace legacy collection from an area that was excavated by Black, the goal was to identify the significance of the 3rd Terrace in relation to the main habitation area (specifically the area known as the East Village), as well as in relation to Mound G (12W54), a potentially temporally and structurally anomalous mound located northeast of the main habitation area.

Third Terrace Legacy Collection

Limited research has been conducted at Angel Mounds outside the limits of the palisade walls and, more generally, the 2nd Terrace. Although palisade walls typically define the boundaries of Mississippian centers and function as *de facto* boundaries for archaeological sites, there is no reason to think that all evidence of occupation or of cultural modification of the landscape stops at these walls. The mere fact that there are several manifestations of the palisade wall at Angel Mounds (Black 1967; Krus, et al. 2012) speaks to the ephemeral nature of them as boundaries in an evolving social, political, economic, and environmental landscape. The area surrounding the site proper was undoubtedly utilized to some extent during the occupation of the site. The first excavations conducted by Black at Angel Mounds on the 3rd Terrace to the east of the site proper provide evidence for this landform's utilization during the site's inhabitation (see Figure 3.1).

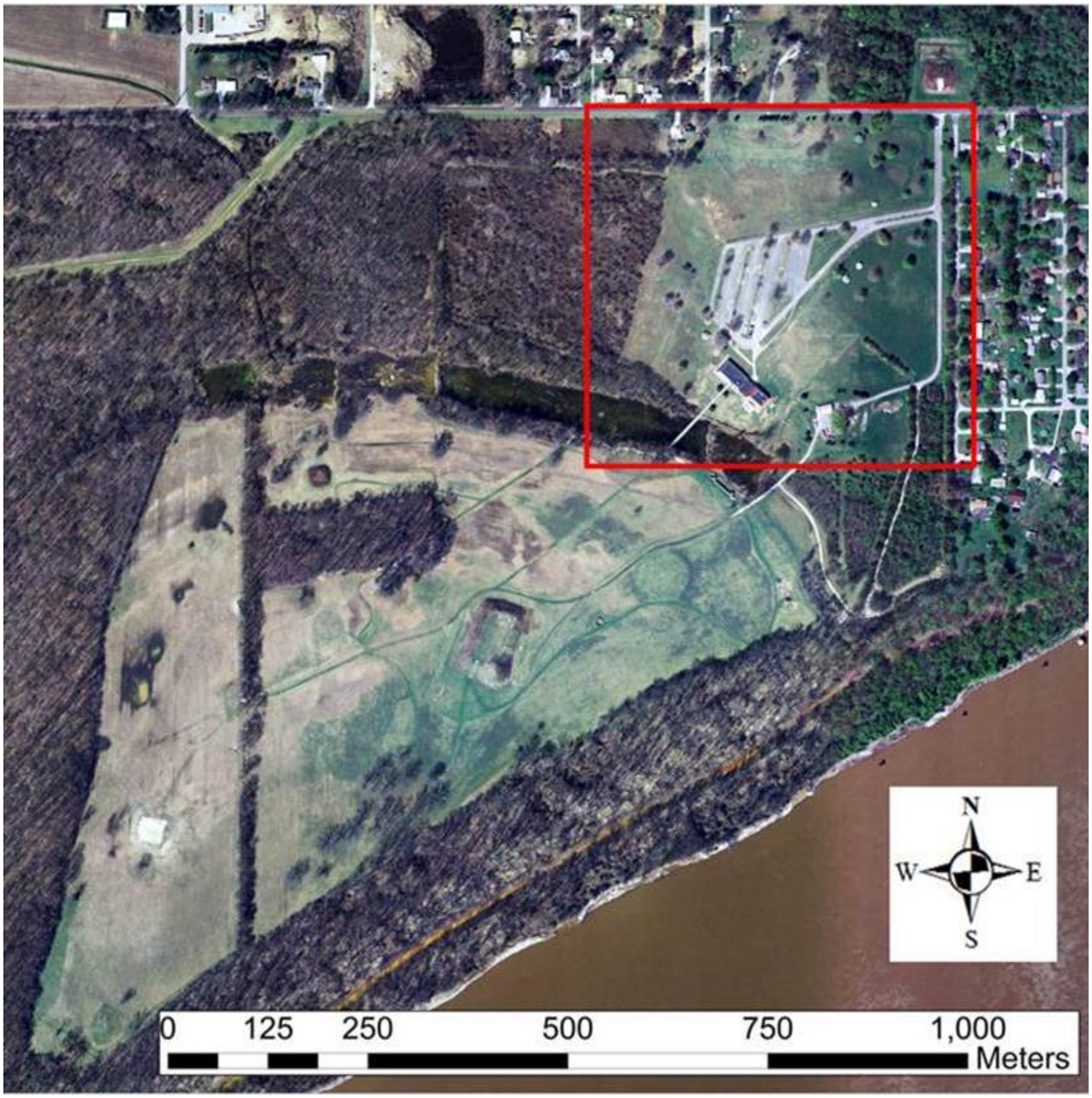

Figure 3.1: 2005 Aerial Photography of Angel Mounds, with the current research area on the 3rd Terrace highlighted

Although over 14,000 ceramic sherds, 3,500 lithics, projectile points, ground stone tools, pipes, ceramic earrings, burnt daub, and charcoal, as well as several human burials were recovered, research was never continued in this area beyond what was minimally necessary for subsequent building construction (Black 1967). The revisiting of this collection, along with Black's original excavation records and maps, was the first component of the three-part research plan to investigate the significance of the 3rd Terrace to the larger site.

Magnetometry at Angel Mounds

Recent developments in and awareness of near surface geophysical remote sensing technology in North America has led to a marked increase in the use of these techniques for both academic and cultural resource management (CRM) archaeology in the United States (Lockhart and Green 2006) and, more specifically, in Mississippian archaeology (Blitz 2010). Angel Mounds has been at the forefront of the use of this investigation technique with Glenn Black and Robert Johnston (1962) performing early research using a proton magnetometer to survey areas of the site in an attempt to locate an iteration of the palisade in the early 1960's. Recent research has continued in this tradition. Stephen Ball (1999) conducted a portion of his doctoral dissertation research at Angel Mounds, testing the applicability of various geophysical remote-sensing techniques on a variety of site types. He found that the Mississippian structures at Angel Mounds were constructed in a way that made them particularly visible to several types of remote sensing. Over the next decade, Staffan Peterson (2010) conducted a magnetometry survey covering a majority of the site within the palisade walls and was able to locate and identify multiple 'neighborhoods' composed of seemingly related structures. A magnetic gradiometer survey of the accessible fields between the palisade wall and Mound G, with a special focus on the vicinity of Black's 3rd Terrace excavations, was the second component of the three-part research plan. This geophysical technique was applied to shed light on prior cultural manifestations of the 3rd Terrace that potentially predate occupation within the village walls.

<u>Shovel Test Survey</u>

One interesting aspect of Angel Mounds is the ephemeral evidence for any occupations on the landform preceding the Mississippian period. Although there have been artifacts that date prior to the Mississippian period, they do not come from any stratigraphic layer or feature that can be definitively associated with an earlier occupation (Black 1967). Similarly, the earliest known dates from Angel Mounds are c.a. 900 years B.P. (A.D.1050-1100) (Monaghan and Peebles 2010). Mound G, however, is an anomaly at the site. It lays outside of the palisade wall roughly 550 meters to the northeast. It is conical in shape and suggestive of mounds created during the Early to Middle Woodland periods (Monaghan, personal communication). Brett Ruby's (Ruby 1997) analysis of Middle Woodland site location potential placed the area in which Angel Mounds lies as having a high probability of containing Middle Woodland occupations. In addition, there are several known ceramic-bearing, Middle Woodland hamlets within a short distance of Angel Mounds, as well as the Martin site (12Vg41), a habitation site with an associated mound. Martin is a Mann phase, Hopewell site located several miles west of Angel Mounds. It was given this temporal designation based on the similarities in artifact assemblages with larger Mann phase sites in the region, such as the Mann site (12Po2) and the GE Mound (or Mount Vernon Site; 12Po885). Because of the location of Martin in a 19th century cemetery, no subsurface excavations have been performed and this designation was based on a surface collection (Ruby 2005). If a Middle Woodland artifact assemblage could be recovered in the vicinity of Mound G, perhaps a similar temporal and cultural designation could be made.

As a result, the third part of the research plan was a shovel test survey of the fields located between the palisade walls and Mound G for the purposes of ground-truthing anomalies noted in the geophysical surveys and to map artifact densities and distributions, which may not be apparent in the geophysical survey. Additionally, high density shovel test survey in the vicinity of Black's 3rd Terrace excavation has been able to determine if the material culture assemblage recovered extends beyond the limits of the 1939 excavation, as well as illuminate geophysical anomalies.

Intellectual Merit & Broader Impact

The intellectual merit of the study is multifaceted. The use of geophysical remote-sensing techniques is a tribute to the pioneering work that Black and Johnston initiated in 1962 (Black and Johnston 1962) and expands upon the work of recent scholars (Ball 1999; Peterson 2010) at Angel Mounds. The use of magnetometry and other near surface geophysical techniques promotes the use of non-invasive remote-sensing techniques as cost-effective and time-efficient techniques that have merit not only in the academic world, but also in the realm of Cultural Resource Management

(Johnson and Haley 2006; Lockhart and Green 2006). Magnetometry is a proven method at Angel Mounds (Black and Johnston 1962; Ball 1999; Peterson 2010), so it clearly has the potential to identify evidence of a Mississippian occupation outside of the palisade wall. Magnetometry has also proven useful as a tool to identify magnetic anomalies associated with Middle Woodland occupations. In addition to his survey of Angel Mounds, Stephen Ball (Ball 1999) conducted a magnetometry survey at the Grabert Site (12Po248), a small Middle Woodland habitation site. Ball found that in the disturbed context of an agricultural field with a long history of use, the magnetometry survey was better able to locate intact subsurface features than the traditional method of systematic surface collection and the subsequent analysis of artifact densities. This technique has also been used effectively at the Mann site, the type site for the Mann phase Hopewell of the Middle Woodland period in southwest Indiana (Peterson, et al. 2007).

While the 3rd Terrace is near the Ohio River, it is not as prone to flooding as the 2nd Terrace on which the palisaded village lays. Therefore, late Holocene alluvial depositions on the 3rd Terrace are minimal. The 3rd Terrace's development and subsequent alluvial deposition likely predate the potential Middle Woodland occupation. Importantly, any temporally distinct occupations (e.g., Hopewell vs. Mississippian) may not be stratigraphically distinct due to the lack of natural deposition (Monaghan, personal communication). However, Middle Woodland and Mississippian features will still potentially leave distinct spatial signatures and, therefore, having a spatially fine resolution image, such as that created by magnetic gradiometer survey, is useful for distinguishing potentially different anomalies.

The shovel testing of the fields between the site's outer palisade and Mound G yielded complimentary information. Because this research was conducted during the 2011 and 2012 GBL and Indiana University field school at Angel Mounds, undergraduate field school students were able to learn proper shovel test survey methodology, arguably one of the most important skillsets necessary for entry-level employment in Cultural Resource Management archaeology.

The revisiting of the 1939 3rd Terrace collection had merit on several fronts. The use of legacy collections has become more common in recent years and represents a more thoughtful, planned, and often limited approach to excavation methodologies (Sullivan and Childs 2003). Used in conjunction with the non-invasive techniques of geophysical remote sensing and the minimally invasive technique of shovel test survey, the 1939 collection, along with the associated documents from the excavation, provided a sense for the possible extent of subsurface deposits in the survey area; it also provided a baseline for interpretation of artifacts recovered from shovel test excavations and the magnetic anomalies noted in the gradiometer survey. Any revisiting of a legacy collection also allows for an assessment of the condition of the collection, of which parts may still be potentially packaged in original field bags, and may allow for rehousing according to modern curational standards.

The broader impact of this work is to contribute to the continuing research being conducted at Angel Mounds by preliminarily investigating an unstudied dataset (the 3rd

Terrace) and adding it to the study of settlement patterns in the “suburbs” of larger Mississippian mound complexes. The analysis of the ephemeral nature of boundaries, such as palisaded walls, contributes to the larger body of research concerning Mississippian settlement patterns at centers such as Kincaid, Cahokia, and elsewhere in the Mississippian world (Muller 1978; Mehrer 1995; Lewis and Stout 1998). This in turn will contribute to larger concepts of temporal changes in spatial patterning and social landscapes. The promotion of the use of non-invasive geophysical remote-sensing techniques as a potential research option for data collection and analysis, as well as feature location, has merit as both a cost-effective and time-efficient research methodology. The utilization of these geophysical techniques allows for a more responsible research methodology, one that can at the same time maximize our ability to record vast quantities of spatial data on archaeological sites while at the same time minimize the creation of underutilized material culture assemblages by promoting targeted and precise excavation practices. In summary, this research examines multiple methodological approaches for an archaeological research program that is both substantive and of minimal impact to intact cultural resources.

Chapter Four - The Third Terrace Excavations

In the spring of 1939, shortly after the acquisition by the Indiana Historical Society of what was to become Angel Mounds State Historic Site, archaeological excavations commenced under the direction of archaeologist Glenn A. Black. The area was a small section of land on the periphery of the much larger site of Angel Mounds – a Mississippian village characterized by the hallmarks of monumental earthen platform mounds, wall trench house construction, and a palisaded wall surrounding the village. Situated on the north shore of the Ohio River, this site is typical in many ways of the larger Mississippian culture that encompassed areas emanating from the major river valleys in the Eastern Woodlands throughout a broad timeframe from A.D. 900 to 1520 (Muller 1997). This timeframe, however, does not correspond to actual occupation periods when applied to local situations, but should rather be considered as bookends for the maximum timespan of various groups considered to be part of the Mississippian whole (Muller 1978; Milner 1986; Monaghan and Peebles 2010; Krus, et al. 2012). There is obviously overlap and gray area at either end of this time period, since no group arises suddenly out of thin air without a preceding founding population and they rarely, if ever, completely disappear.

Angel Mounds falls well within this Mississippian timespan. According to recently acquired ^{14}C dates obtained from soil cores from the base of the largest mound at the site (i.e., Mound A), the beginning of construction on the mound began as early as A.D. 1050-1100, which is among the earliest dates at the site (Monaghan and Peebles 2010). This corresponds with the earliest dates of many other similar Mississippian sites in the Ohio River Valley, placing the beginnings of Angel Mounds within a broader regional emergence of Mississippian centers in the area (Monaghan and Peebles 2010). ^{14}C dates at the site are consistently present until roughly A.D. 1450, which is for all intents and purposes considered the date of abandonment for Angel Mounds (Baumann, et al. 2011).

All of this data, however, has been revealed much more recently than the investigations that were undertaken by Glenn Black from 1939 through the early 1960's. Originally an avocational archaeologist, Black gained the respect and confidence of Eli Lilly and the Indiana Historical Society, leaders in Indiana archaeology at the time, who hired and trained him to lead the research at Angel Mounds. Funding and labor for the bulk of the excavations at the site were provided by workmen in the Works Progress Administration program as part of President Roosevelt's New Deal and were conducted between 1939 and 1942 (Black 1967). While none of these workmen had any prior experience in archaeological excavation, the excavations on the 3rd Terrace were where many men 'cut their archaeological teeth' for the years of excavation to come at Angel Mounds. As Black stated – "The area, therefore, not only served as a training ground for men who would ultimately be classed as semiskilled workers, but also as a screen through which some passed and others did not" (Black 1967:102). This insight from Black provides a backward facing lens upon the type of men (and some women) who were directly involved in the creation and conception of this collection.

The strategies involved in the excavation of this assemblage were varied and make it more difficult to produce a standardized analysis of the collection or a spatial analysis of artifact distributions. The initial excavations on the 3rd Terrace began as training exercises for the initial WPA crew on excavation technique along with artifact and soil type recognition. During the demolition of structures that were in the area the crew had chosen as their base camp, a number of archaeological materials had been noted. In addition, the presence of an existing cellar from a farm once located on the property provided an easy way to observe a potentially 'average' soil profile of the area, once the bricks were removed and clean faces troweled to expose a 'natural' profile. During this process, an old humus line was noted, which gave the impression of a previous ground surface that had been buried during the excavation of the cellar. While exposing this old ground surface, the first subsurface artifacts and features were found, including a broken celt, 3 separate concentrations of ceramic sherds, and a 'fired area' that led Black to suggest even at this early stage that this "seemed to indicate that here was a dwelling site probably coeval with the major occupation of Angel Site lying across the slough to the west" (Black 1967:90).

Although he may not have known it at the time, Black seems to have accurately depicted the large amount of material that was excavated on the 3rd Terrace. His designation as a dwelling site is a very plausible explanation for the presence of this assemblage outside the palisade walls of the site proper. In terms of total counts of artifacts recovered from this excavation as recorded by Black, the numbers are as follows -- roughly 14,000 ceramic sherds (12 of which were painted); 8 triangular points; 6 celts (one of which was chipped and polished quartz and another of the spatulate type); 2 pottery pipes; 6 notched and/or stemmed points; 1 pottery trowel; 2 flake knives; 2 abrading stones; 2 anvils; 1 pottery earring; 1 pottery ear plug; 1 pottery disc; 1 specimen of worked cannel coal; roughly 3,500 lithic samples; and 3 (and possibly as many as five) human burials (Black 1967). These designations are based upon the initial designations in the field and through the initial stages of processing that were done on-site by WPA crew. A word of warning, however, on the reliability of these designations is contained in Black's volume - "much of the original sorting had been accomplished by conscientious but relatively untrained WPA workers and the record card notations were all too brief and not always a reliable indicator of the specific artifact qualities. Some items proved on closer inspection to be something other than indicated. And, of course, the catalogue could not accommodate changes in archaeological interpretation occurring over the course of two and a half decades [at the time of writing in 1967]. The point is that the materials could not be described or even accurately enumerated from the perspective of the catalogue alone" (Kellar 1967:431). A reanalysis of this portion of the collection was warranted, in this case, rather than basing any inferences upon the artifact catalogue alone.

Since a large part of the analysis of any collection is an understanding of the context in which it was created, both by those who created the assemblage (Mississippian peoples of Angel Mounds) and those who excavated it (Glenn Black and the WPA crew), some space must be devoted to these groups. Since neither are available for interview (with the exception of one man from Black's WPA crew who still resides in Evansville, IN at the age of 92 (Baumann, et al. 2011)), they must be interpreted through the analysis of text. In this sense, the descriptions of the workmen of the WPA crew can be considered somewhat analogous to early ethnographic accounts of Southeastern peoples made by the first European explorers in the area. While Black's (1967) volume provides some decent descriptions of the general atmosphere and daily life of WPA workmen at Angel Mounds, ethnohistoric accounts for this region of the Ohio River Valley are nonexistent for the timeframe in which Angel Mounds was occupied. Black himself attempted to conduct an ethnohistorical survey of the Southeast in general, utilizing sources varying from Spanish conquistador Hernando De Soto's expedition through the Southeastern United States from 1539-1542, to records of the French explorations over a century later around the Mississippi River and Louisiana, to English accounts of the Southeast during the late Contact and early Colonial periods. Charles M. Hudson has done extensive research on the potential route of the earliest of the inland explorations, that of Hernando DeSoto. His estimations have DeSoto reaching portions of northern Tennessee along the Mississippi River (Hudson, et al. 1984), well within the Mississippian cultural sphere, if not a slightly after the last dates we have archaeologically for Mississippian cultures (Muller 1997). Fortunately, many of the accounts exhibit a broad trend of general cultural continuity among native peoples in the area, potentially making their relevance significant for portions of the Mississippian period as well (Black 1967). Many of the accounts, spanning a large portion of the time from DeSoto to the Colonial period, speak of similar ways of life including house structure, 'chiefs houses' on mounds, temples upon mounds, descriptions of a town square or plaza, public buildings, bastioned palisade walls, burial practices, and many other accounts of 'village life' (Black 1967). While not all are completely consistent with each other in detail across space and time, there are enough similarities to use these sources, albeit carefully and with an eye for early biases, as a potential resource to interpret the collections from Angel Mounds.

As we can no longer speak with Black about his impressions of the WPA crew, it is worth noting some of his description of the earliest stages of the project at length here. It speaks not only to collection strategies and rationale for excavations, but also to the type of people who were in essence creating this collection and some of the feelings they attached to the project and to the materials themselves.

> "…we began excavations on a small scale with a very few men who had been selected from the original assignment of twenty. The initial subsurface excavation was in an area where we had not originally anticipated digging. We took advantage of an unfilled cellar area – part of a very old dwelling which had been razed. Our intention was merely to remove the brick walls and clean the exposed profiles to determine what the soil types were on this alluvial terrace. We were pleasantly surprised to find a stratum containing aboriginal debris not far below the surface. This small excavation, which actually turned into one of interesting proportions, permitted us to watch the men at work with trowel and shovel. Some took to it immediately, while others did not. It was soon obvious that a few would be of value only with a wheelbarrow, others could be used to clean up by shovel the earth which had been removed by trowel. A surprising number of the group were adept at using the trowel and were soon skilled in removing the matrix of earth from around objects and features which were to be left *in situ* [emphasis original]. These men were ready to be reclassified to the category of "archaeological excavator," with a slight increase in hourly wage rate, as soon as activities were accelerated. This procedure provided some incentive for better work and stimulated the men considerably. It was the basis for setting this particular project apart from others upon which the men had labored. No such opportunities were offered on projects such as road grading, ditch digging, removal of city streetcar tracks, etc.
>
> In terms of promotions, during the life of the project we were able to elevate some men who had begun as laborers to the position of foremen. Also we made it a point always to compliment a workman for a job well done. To most of them this proved to be a unique experience. Sometimes this attitude had near serious results. An archaeological

excavator might become very "possessive" of the feature or burial he had been assigned to work upon. Until the task was completed to the satisfaction of the workman or supervisor, no other worker could touch it." (Black 1967:23)

"With the pay period beginning December 27, 1939, a new training period began. The material recovered during the preceding eight months had to be washed, classified, and catalogued. During the fall months as individuals completed their terms of employment, replacements had not been ordered. The work force was thus intentionally reduced to about thirty men, five of whom could be kept busy working on the topological survey. Something over twenty men, on the average, were available for processing material. Four men, by reason of age and/or physical handicap, were retained to wash specimens. Others were tested for skill and aptitude in the use of a crow quill pen and India ink to be used in applying catalogue numbers to specimens. Others wrote catalogue cards and still others packed material in storage cases. One man devoted full time to restoration of pottery and other broken specimens. All of the material excavated in 1939, as well as a quantity of specimens collected on nearby sites, was catalogued by May 1, 1940, when work outside was again resumed. This precedent of completely processing all material on hand before another excavation began was never deviated from at Angel Site. We never were able again, though for the duration of the WPA project, to suspend completely the processing procedure. Material came in too fast from the three excavating units to allow it to accumulate. We attempted to maintain a balance between field work and laboratory processing so that at no time was a large mass of material uncleaned and uncatalogued. It was almost providential that this "rule" was enforced. With the rather sudden, although not unexpected, termination of the projects [with the advent of WWII], we might well have found ourselves with a good many thousands of specimens unwashed, uncatalogued, and unclassified."

(Black 1967:24)

The WPA crew and Black can also be thought of as 'creators' of this collection, almost as much as the Angel Mounds' Mississippians. Collection strategies, biases, and relative inexperience all contributed to the types of artifacts that were collected. Standard practice for excavation today involves screening dirt through ¼ inch mesh and many sites now use water screening though window screen, saving nearly everything that comes out of the ground. All excavations at Angel Mounds today are screened using this technique. As a result of this practice, we can now answer questions whose basis lies in extremely small artifact classes. Examples include the importance of gathering versus hunting based upon microfloral remains such as seeds, ichthyoskeletal, and small mammal remains, and lithic production and reduction strategies based upon micro flake analysis. During the WPA era and many (if not all) of the excavations by IU field schools led by Black into the 1960's, screening was not standard practice. Therefore, all material recovered was identified by manually sifting through soil matrix to identify and collect any artifacts. While this is woefully lacking by today's standards, for the time, Black's collection strategies were much less biased than others. This can be seen in his description of the decision to save 'everything' –

> "A word should be added here as to what was saved and what was discarded. Since the workmen previously had known nothing about archaeology or archaeological specimens, it was impossible to allow them to exercise any discrimination. Everything, therefore, encountered by the men during the digging day other than the matrix soil was saved and placed in the specimen containers…Actually, there has been little discarding through the years, for on a site where every stone and bone has been deposited by man, everything other than dirt can add to the story which the site has to tell – and even the dirt can be revealing upon many an occasion"
>
> (Black 1967:84-85)

Black's rationale for this collection strategy was sound with a basis in the statistical comparison of "exotic" types such as painted, incised, or textile impressed ceramics, which may stand out and be disproportionately collected if a strict system was not in place. As he correctly argues, this allows for a more sound statistical comparison of these types to the overwhelming majority of plain body sherds that would have potentially been discarded at another site during excavations of this time period.

However, as we now know, Black's collection strategies were not entirely consistent, and definitely not complete. Recent work from 2010 involving Indiana University and researchers from the GBL attempted to quantify the number of artifacts and artifact types that were not collected during the WPA investigations. Methodologically, this consisted of reopening a backfilled WPA era excavation (specifically located on the main site in the area of the East Village along the northern boundary of Subdivision W-10-D). Standardized soil matrix samples were taken at meter intervals from the backfill along the entirety of the 19.5-meter trench. These samples were 19 dm^3 in size (one 5 gallon bucket each). They were water screened to collect a sample of all artifacts Black 'discarded' (intentionally or unintentionally). This then provided a baseline of the type and amount of artifacts not collected when compared to the total number of artifacts collected during the WPA excavations (Krus and Marshall 2011).

There is an obvious difference in the proportions of artifacts collected by type. The WPA excavators did not systematically collect cannel coal, chert flakes, mica and shell. Shell is the only class of these artifacts that was collected at all, although based upon the calculations done in 2010, 98.66% of shell was not collected. Black and the WPA collected chert objects (projectile points, hoes, knives, etc.) and ceramics with much more consistency, but a significant portion of these artifact classes were still recovered from the backdirt. When adjusted for the difference in volume between the samples and the original excavations, 17.76% of chert objects were not collected and 23.87% of ceramics were not collected, including examples of decorated ceramic, such as negative painted varieties (Krus and Marshall 2011).

In terms of applying this method of artifact density estimation to the 3rd Terrace, there are several problems. Subdivision W-10-D was excavated beginning on May 23rd, 1941, more than two years after excavations on the 3rd Terrace were begun in April of 1939. This is problematic for several reasons. These two excavations are very different in the type of archaeological remains encountered. The number and type of features, as well as the variety and sheer volume of artifacts, are indicative of two very different contexts for these areas of the site. Seventy-six 10-ft^2 blocks were excavated on the 3rd Terrace to an approximate depth of 2 feet, while 96 (almost the full subdivision) were excavated in Subdivision W-10-D. In Subdivision W-10-D, approximately 400,000 ceramic sherds were reported being collected by Black, while only approximately 14,000 were recovered from the 3rd Terrace. Only 15 or so (no exact number is given) artifact types were recovered from the 3rd Terrace, while 86 were recovered from Subdivision W-10-D. In addition, 56 human burials were excavated from Subdivision W-10-D, while only three were excavated on the 3rd Terrace. Much of this is likely due to the disproportionately large number of features present in Subdivision W-10-D when compared to the 3rd Terrace. Within Subdivision W-10-D are multiple manifestations of the palisade wall, (including bastions), fireplaces, pit features, irregular circular structures, and a myriad of overlapping wall trenches and post-holes representing an extremely dense occupation surface. The features of the 3rd Terrace, however, are restricted to a relatively small number of 12 pit features of various sizes, as well as several historic pit features and several post-holes, which Black deemed historic (Black 1967:85-104).

Black attempted to retain as many people as possible because of the familiarity that was needed to conduct archaeological work and the training necessary to make WPA workers effective archaeological excavators. However, after two years and a large expansion of the excavation program, there were likely few people who participated in both excavations other than Black. Being the first excavations on the site, the 3rd Terrace excavations were undertaken by men who had no experience whatsoever in archaeological excavation, while those who excavated Subdivision W-10-D likely had a good bit of experience under their belt at that point. But, because of the small crew size and relative inexperience of the 3rd Terrace crew, Black was likely much more intimately involved in this excavation and work may have progressed much more slowly, allowing time for additional artifacts to be seen and collected. This was especially true in the very first blocks excavated in Subdivision X-7-D of the 3rd Terrace, where all individual artifacts were piece-plotted, not only two dimensionally, but also for depth, as a method of determining the relative depth of a potential living surface (Black 1967).

Without conducting a similar test of collection discrepancies similar to the work from 2010, it is impossible to know the relative percentages of artifacts not collected for the 3rd Terrace. However, because of the lack of screening of soils in the 1939 excavations, it is almost certain that a number of artifacts were never collected, and 23.87% seems to be a reasonable estimation of this phenomenon for lack of more specific data. However, as this rubric has not yet been applied site-wide, nor has it been independently tested in other areas of the site, comparisons must be made between original counts when no other data are available.

At the beginning of the excavations on the 3rd Terrace, one attribute of the ceramics that was noted immediately was evidence that the ceramics had been manufactured using shell tempering technology similar to other sherds that had been collected by avocationalists over the years within the confines of the main site. This falls in line with the wider Mississippian tradition of the utilization of shell tempering technology (Hilgeman 2000; Feathers 2006). This was noted in the early historic period in the Southeast as well by Dumont – "[The pottery's] strength can only be attributed to the mixture which the women make of the powdered shell with the clay" (Dumont in Swanton 1946: 550). However, one main distinction between the 3rd Terrace ceramics and those from the site proper was that the sherds from the 3rd Terrace seemed to have been subjected to acidic conditions during their taphonomic history, effectively dissolving a large amount of the shell from the ceramics themselves. Evidence of this was what Black termed "cells" within the sherds corresponding to the missing shell temper (Black 1967:90).

This apparent effect on the variability of taphonomic processes (noted in Black's observations of the differences between the 3rd Terrace and the main site) upon the assemblage should caution interpretations that can be gleaned from this material when compared to the main site area. Based upon analysis of the 3rd Terrace collection during the current research, there are some examples of ceramics in which shell tempering survives intact and the sherds in which the shell has been leeched out, resulting in the telltale remnant "cells," which allow for a relatively consistent temper designation, even with the lack of physical shell. While this variability in soil conditions, specifically acidity, has not been fully investigated, this anecdotal account may have the potential to inform us about other taphonomic changes that have occurred in the 3rd Terrace collection, some of which will be discussed later.

As has been stated before, by far the largest component of both the Angel Mounds and 3rd Terrace collections are their ceramic components. When the entire Angel Mounds collection was summarized in the 1967 Angel Mounds volume (including the small portion which is the 3rd Terrace), Kellar writes that there is in excess of 1.8 million artifacts, of which pottery represent slightly more than 99% of the total. The remainder is a fairly substantial 12,000 items, but pales in comparison to the number of ceramic artifacts (Kellar 1967). One interesting discrepancy in the numbers reported for Angel Mounds as a whole and for the 3rd Terrace alone is the number of lithic samples that Black claims to have collected from the 3rd Terrace, numbering roughly 3,500 (Black 1967:102). This number is obviously not included in Kellar's final tabulation of non-ceramic artifacts, as this would represent more than a quarter of the number reported for non-ceramic artifacts from the whole of Angel Mounds. Kellar does, however, report many artifacts of chipped and groundstone technology, including 1407 projectile points, 87 blades, 135 perforators, 219 scrapers, 102 flake knives, 39 celts (chipped stone), 139 celts (groundstone), 17 spades (hoes), and an assortment of other ground stone technologies, including mortars, hammerstones, abraders, discoidals, ear pins, plugs, beads, pendants, pipes, effigies, and more (for a full listing of types, numbers, and descriptions, see Kellar's report on Material Remains in Black 1967).

It was first assumed that Black was quantifying all artifacts related to stone tool manufacture (specifically flakes and other lithic debitage). However, Kellar also includes a section of 647 worked stone artifacts that includes many unidentified groundstone implements, but also some chipped stone examples, which include “a smooth edge, minor edge chipping, [and/or] indications of wear” (Kellar 1967:448). This seems to indicate that Kellar included in this list utilized flakes, cores, and similar artifacts of obvious modification, but may not have included generic flakes from simple lithic reduction and tool manufacture, especially pressure and thinning flakes that would have been less likely to have been recognized and collected by WPA workers who were unfamiliar with the details of stone tool manufacture. Black does not elaborate on the type of lithic material that has been collected from the 3rd Terrace and, at this time, a reanalysis of the lithic portion of the collection has not been undertaken. The Field Specimen Record Logs from the 3rd Terrace do list ‘Flint Chips’ as artifacts that are periodically collected, as well as several recorded as ‘Flint & Sherd’, but the vast majority of entries are either listed as ‘Sherds’ or simply ‘Misc. Material’. At this time there is no reason to assume that Kellar ignored the 3rd Terrace material, but perhaps included Black’s ‘lithic samples’ under his heading of “the abundant contextual data and nonartifactual remains totaling several million pieces” (Kellar 1967:431), which he obviously has not included in his total of 1.8 million artifacts.

As evidence of the ever-evolving definitions that archaeologists assign to material culture, the percentage of the Angel Mounds collection that Hilgeman classifies as ceramic is 70% (Hilgeman 2000:25) as opposed to Kellar’s 99%. While this included all materials that had been excavated up to her publication in 2000, including proportional differences in collected materials due to modern collection strategies, it also is likely a result of the reclassification of a large amount of material culture that was previously not categorized as an 'artifact'. This is another example of the problems that Kellar alluded to previously, which arise from creating inferences about the collection from the catalogue alone.

The most recent published study that has utilized a portion of the 3rd Terrace collection is *Pottery and Chronology at Angel* (Hilgeman 2000). All terminology used to describe the ceramic collection of the 3rd Terrace is taken directly from Hilgeman. Meanwhile, the quantitative techniques that she developed for measurement and classification of vessel form are used in this study as well. Similarly, the ceramic types and varieties that she defines at Angel Mounds are the types and varieties used in this study to classify the collection. Hilgeman's study focused on the creation of a chronological seriation of the Angel Mounds' ceramic assemblage based upon decorative modification and, to a lesser extent, vessel morphology. Therefore, while the size and goal of her analysis was much larger than what is attempted here, the breadth of artifacts that she examined was much narrower. Her sample included 22,383 individual sherds, representing just over 1% of the ceramic assemblage and consisted of all known decorated or modified sherds (Hilgeman 2000). This did not, however, include the most common modifications of textile impressed and cordmarked sherds, which she classified with the plainware sherds. Using her terminology, sherd can refer to a ceramic fragment, reconstructed vessel, or whole vessel. The minimum number of vessels was not estimated and all calculations are based upon the 'sherd' unit.

As was mentioned earlier, Mississippian ceramics are typified by shell tempering technology. Although this technological innovation is by no means absolute for Mississippian ceramics, it constitutes the vast majority (Hilgeman 2000). Hilgeman began her classification by first dividing ceramics into coarse and fine shell tempers, typically also corresponding with differences in the quality of the finished product. These ranged from a rough, only partially smoothed exterior and relatively thicker and bulkier vessels associated with coarse temper, to polished, thinner, and more gracile vessels associated with a finer ground temper. The coarse tempered ceramics are termed 'Mississippi Ware' and the finer tempered ceramics are termed 'Bell Ware' (Hilgeman 2000).

While a large majority of decorated sherds that are used in her analysis, including all painted and many slipped varieties, were of the finer tempered Bell Ware, there is a significant portion of the coarser Mississippi Ware examples, which exhibit incising, stamping, punctuation, or pinching as a decorative modification as well. The defined pottery types that Hilgeman uses for her analysis are as follows, with their sherd count and relative proportions (of the total number of decorated sherds at Angel Mounds) based on sherd count following in Table 4.1. Mississippi Plain sherds, including textile impressed and cordmarked varieties, constitute roughly 98% of the assemblage, while decorated sherds make up the remaining 2%. Of the coarser Mississippi Ware, the plain type is Mississippi Plain; the cord-marked type is McKee Island Cordmarked;

incised types with arch motifs are Matthews Incised; incised types with a rectilinear Guilloche motif (appears as lines seeming to twist around each other) are Beckwith Incised; incised types with triangle motifs are Barton Incised; a fingernail punctated type is Parkin Punctated; a pinched type is Pouncy Pinched; and a check-stamped type is Wolf Creek Check Stamped. As for the finer Bell Wares – the plain type is Bell Plain; a red-slipped type is Old Town Red; negative painted plates are Angel Negative Painted; negative painted bottles are Kincaid Negative Painted; negative painted with a white slip is Nashville Negative Painted; negative painted and red painted is Sikeston Negative Painted; red painted is Carson Red on Buff; incised with a triangle motif is O'Byam Incised; incised with parallel lines is Mound Place Incised; incised with scrolls is Ramey Incised; and the stamped type is Vanderburgh Stamped.

Table 4.1: Angel Mounds Ceramic Types - Decorated Ceramic Counts and Percentages

Mississippi Ware				Bell Ware		
Type	**#**	**%**		**Type**	**#**	**%**
Mississippi Plain	*	*		Old Town Red	8663	53.3%
McKee Island Cordmarked	*	*		Angel Negative Painted	3997	24.5%
Parkin Punctated	245	1.5%		Bell Plain	2217	13.6%
Pouncy Pinched	37	0.23%		Kincaid Negative Painted	560	3.4%
Matthews Incised	32	0.19%		Vanderburgh Stamped	191	1.1%
Beckwith Incised	27	0.16%		Carson Red on Buff	91	0.56%
Barton Incised	16	0.098%		Ramey Incised	90	0.55%
Wolf Creek Check Stamped	6	0.037%		O'Byam Incised	44	0.27%
				Mound Place Incised	19	0.12%
				Sikeston Negative Painted	13	0.079%
				Nashville Negative Painted	3	0.018%

*Mississippi Plain and Mckee Island Cordmarked are included in the ceramic types, but not when considering percentages of decorated sherds. They make up a portion of the undecorated sherds that constitute 98% of the Angel Mounds ceramic assemblage.

(Hilgeman 2000)

Twenty-three of the 22,383 sherds Hilgeman examined came from the 3rd Terrace excavations. Since these 23 items have the most information recorded about them in the context of the analysis of the larger Angel Mounds ceramic assemblage, and since her analysis provides the foundation for the current research with the collection, they are discussed in some detail here. Of these 23, five are complete vessels, nine are rim sherds, seven are body sherds, and one is a detached decorative attachment common to Mississippian ceramics called a 'rim rider'. All of these artifacts were either manufactured using red or black slip, modified to include incised lines in decorative patterns on the vessel, and modeled to form an effigy either as an element of the vessel or as the whole vessel (or had handles present that were used in part) to create the relative ceramic chronology. An additional aspect of the ceramics analyzed was the type and quality of temper used in the manufacture of the pottery. Of the 23 sherds that were examined from the 3rd Terrace, eight were determined to be plates, four were determined to be jars, five were determined to be bowls, one was a bottle with a jarform body, and five were not able be determined. A complete list of the 23 sherds that were examined by Hilgeman is listed in Table 4.2.

According to Black and Kellar, most of the painted and obviously decorated and modified ceramic sherds, including complete vessels, were separated from the remainder of the ceramics that were recovered in the proveniences that they shared, leaving the remainder, which was catalogued as simply 'Sherds' in the FS logs (Black 1967; Kellar 1967). When the current reanalysis of the 3rd Terrace ceramic collection commenced, the artifacts were in very good condition, although they were not curated following modern standards using acid-free materials. All materials from the 3rd Terrace were housed in nine cardboard packing crates, divided roughly by their designated subdivision and FS within their original paper field bags. Written on these bags was their provenience information, as well as a total count of the number of sherds that were contained within each bag, which must have been added as they were being processed. Additionally, textile impressed sherds and rim sherds were almost always already separated from the plain ware body sherds and, if there was anything out of the ordinary such as a detached handle or an incised sherd, they were usually separated as well.

Careful examination of the excavations and the material culture recovered from the 3rd Terrace is essential in developing a framework within which further research in the area can be conducted. As described earlier in the section, excavation technique and methodology from the 3rd Terrace varied from some of the practices on the main site. In addition, it seems apparent that soil conditions vary from the 3rd Terrace to the main site as well. The variety and number of recovered artifacts and features also vary from the 3rd Terrace to the main site, speaking to likely differences in the function of this area of the site. All of these elements have been taken into consideration during the geophysical investigations, as well as the reanalysis of the 3rd Terrace collection.

Table 4.2: 3rd Terrace Decorated Ceramics – Prior to Reanalysis					
Vessel Form	Type	Vessel Portion	Molded/Incised	Slip/Paint	Primary Temper
Simple Bowl		Complete Vessel	Indeterminate Effigy		Finer Shell
Simple Bowl		Complete Vessel	Bird Effigy		Coarser Shell
Plain Bottle - Narrow Neck		Complete Vessel		Black Slipped	Finer Shell
Standard Jar		Complete Vessel & Handle			Coarser Shell
Standard Jar		Complete Vessel & Handle			Coarser Shell
Standard Jar		Complete Vessel & Handle			Coarser Shell
Bottle or Bowl	Old Town Red	Rim		Red Slipped	Finer Shell
Indeterminate Plate - Plain	Old Town Red	Rim		Red Slipped	Finer Shell
Indeterminate Plate - Plain	Old Town Red	Rim		Red Slipped	Finer Shell
Indeterminate Plate - Plain	Old Town Red	Rim		Red Slipped	Finer Shell
Indeterminate Plate - Plain	Old Town Red	Rim		Red Slipped	Finer Shell
Plain Plate	Old Town Red	Rim		Red Slipped	Finer Shell
Misc. Bowl - Plain	Old Town Red	Body Sherd		Red Slipped	Coarser Shell
Misc. Bowl - Plain	Old Town Red	Body Sherd		Red Slipped	Coarser Shell
Deep Rim Plate	Old Town Red	Body Sherd		Red Slipped	Finer Shell
Indeterminate Plate - Plain	Old Town Red	Body Sherd		Red Slipped	Finer Shell
Indeterminate Plate - Plain	Old Town Red	Body Sherd		Red Slipped	Finer Shell
Outflaring Bowl - Misc.	Mound Place Incised	Rim & Open Handle	Open Handle - Trianguloid Incised Flat Lug	Black Slipped	Finer Shell
Standard Jar		Rim & Strap Handle			Coarser Shell
		Body Sherd	Misc. Incised	Black Slipped	Finer Shell
		Body Sherd	Misc. Incised	Black Slipped	Finer Shell
		Rim & Open Handle	Trianguloid Incised Flat Lug	Black Slipped	Finer Shell
			Detached Rim Rider - Bird		Finer Shell

(Hilgeman 2000)

Chapter Five - Magnetometry

> "…the necessity of small excavation areas has forced a particular mindset onto the discipline that views human spaces in terms of tens of square meters rather than in tens of hectares." (Kvamme 2003:454)

The second section of this research project involved a 7.83 hectare magnetometry survey of the 3rd Terrace, an alluvial geological formation above the 2nd Terrace on which the main site is located. The 3rd Terrace edge is roughly 3 meters higher in elevation than the 2nd Terrace, effectively placing it outside of the reach of floodwaters from the Ohio River, which regularly inundate the site. While the historic plowing activity that was common on both the site and the 3rd Terrace would potentially disturb the top 25-30 cm of soil, the potential for underlying cultural features that could be detected by magnetic survey as magnetic anomalies was still considered to be good.

As a method of archaeological investigation, magnetometry is a relatively new technological innovation to the archaeological toolkit (Aitken, et al. 1958). Published in *Antiquity* in 1958, M. J. Aitken's experimentation with the new technology was able to accurately measure magnetic field strength to locate a Romano-British pottery kiln. While this test of the detection of the relatively strong thermo-remnant magnetism was successful, he also noted that pit features that had been infilled with different material from the surrounding subsoil were able to be detected as well (Aitken, et al. 1958). Aitken's early impressions of the technology were that "the method appears to have wide application in archaeology" (Aitken, et al. 1958:271).

As a remote sensing method, magnetometry has many advantages over other geophysical methods, such as electrical resistivity and ground penetrating radar. The ability to cover large survey areas in a relatively short period of time while at the same time collecting relatively high spatial resolution data makes magnetometry one of the most applicable and widely used geophysical remote sensing techniques. Magnetometry is also a survey method that is appropriate to use in a wide variety of environmental and soil conditions, making it standard practice for geophysical remote sensing surveys (Kvamme 2006).

The applicability of magnetometry is based upon measurements of abnormal, localized fluctuations in the earth's magnetic field created by objects or features within the ground that have been altered magnetically through cultural or natural processes. The basis of the technology, therefore, is both the earth's wider magnetic field, as well as inherent magnetic properties of natural materials, which are affected by cultural and natural processes. The earth's magnetic field is present because of the planet's molten iron core and its relative strength is measured today in nanoTeslas (nT), formerly known as a *gamma*. Like any magnet, the magnetism of the earth is stronger at the poles and grows weaker the closer one is to the equator. In terms of nT, this means that earth's magnetic field measures roughly 60,000 nT at the earth's poles and roughly 30,000 nT near the equator (Weymouth 1986:341). The magnetic field strength at any given location on the planet can also be affected by solar radiation, causing fluctuations in the ambient magnetic field strength from day to day and throughout the course of a single day.

For archaeological remote sensing purposes, this is important because archaeological materials and culturally modified soils can vary from the surrounding magnetic field strength by less than ±1 nT and, in some cases, as little as a picoTesla (0.001 nT) (Becker 1995). There are several ways in which archaeological materials acquire or present a magnetic signature that is detectable through magnetic survey. Two types of natural processes act upon materials to change their magnetic signature. All soils, sediments, and rocks exist within the earth's magnetic field. The ability of these materials to become magnetized within the presence of that field is termed *induced magnetism* and is dependent upon the presence of magnetizable materials, mainly the three oxides of iron: hematite, magnetite, and maghemite. Of the three, only magnetite and maghemite are significantly magnetic (Clark 2000). Most soils, clays, and rocks contain between 1 and 10 percent of these iron oxides. These materials are relatively insoluble when compared with other, less magnetic materials and are therefore concentrated within topsoils over time (Aitken 1970). Additionally, fires, both natural and anthropogenic, reduce hematite to more magnetic magnetite and maghemite (Dabas and Tabbagh 2000). Magnetotactic and other bacteria also concentrate magnetic compounds in topsoil layers (Fassbinder, et al. 1990). Therefore, based upon these various processes, topsoils in areas that are occupied by people for extended periods of time tend to accumulate magnetism.

In addition to the concept of induced magnetism, there is also a process known as thermoremnant magnetism, which can similarly alter magnetic signatures. Thermoremnant magnetism has its basis in the same 1 to 10 percent iron oxides that are part of most soils. These iron oxides each have a magnetic domain (an alignment of their magnetic polarity) that line up with the earth's magnetic field at the time they were last exposed to heat in excess of 600^{o}C, what's known as the Curie Point. Therefore, igneous rocks, those formed through cooling of magma, have a strong magnetic signature due to the combined strength of these magnetic domains and are not ideal areas in which to perform magnetic surveys. In other areas, however, through taphonomic processes these domains become randomly oriented, effectively canceling each other out and creating a neutral magnetic signature. However, when materials are reheated above the Curie Point, their domains simultaneously realign to the current magnetic north and their magnetic signatures compound upon one another rather than cancel each other out and create a permanent magnetic signature that can be detected through magnetic survey (Aitken 1970; Clark 2000). It should be noted that both these forms of magnetism are identical when detected by magnetic survey equipment.

A number of cultural processes act in conjunction with the natural magnetic processes and have been documented as affecting the natural environment in a way that alters the way in which magnetic signatures present themselves as magnetic anomalies. Seven have been listed by Kvamme (2006) and have been gathered from several other scholarly works (Weymouth 1986; Scollar, et al. 1990; Clark 2000). They are as follows – 1) People create fires – Fire is one of humanity's oldest innovations and has been used to alter our cultural landscape throughout that history. Cooking fires, accidental structural fires, technological innovation, such as firing of ceramics and smelting metal, which require hot fires, and many other processes can all heat surrounding soils to above the Curie Point, thereby altering their magnetic signature. 2) People make constructions and artifacts composed of fired materials – Fired bricks, fired ceramics, and other fired materials have the potential to show up in a magnetic survey if the survey is of sufficiently high spatial resolution and are in large enough quantities to register magnetically or be in non-natural patterns (such as a square house foundation of brick). Fired materials also contribute to a generally higher magnetic signature in areas that have been heavily occupied or have extensive occupation periods. 3) Human occupations exacerbate magnetic enrichment of surface soils – As noted above, several natural processes, such as fires and bacterial growth, are exacerbated by human occupation and the introduction by people of fire, fired materials, and organic waste promotes bacterial growth into the soils. 4) Human constructions' accumulate topsoil – Magnetically enriched topsoils that are accumulated by humans have a compounded magnetic signature. Examples of this may be the construction of mounds or the infilling of pits with organic topsoils. 5) Human constructions remove topsoils – Borrow pits, grave shafts, and wall trenches are all examples of human modification of the environment that will either leave an area stripped of magnetically rich topsoils, or which may be infilled with magnetically quiet subsoils, leaving a magnetically weak signature. 6) People import stone and other materials for construction – When people import foreign or exotic materials into an area, their magnetic signatures may be different from the ambient background magnetic signature of the native soils. 7) People make iron artifacts – Iron, being highly magnetic, is easily detectable by magnetic survey and often overshadows magnetic variation that is of a smaller spectral variance.

Detecting the magnetic signature of any of these cultural and natural processes depends upon the contrast of the magnetic signature of the feature that is potentially being detected to the ambient background magnetic signature of the surrounding environment. If soils are not significantly different in terms of their magnetic signatures, then they will be effectively invisible in the final survey image. For this survey, the specific type of magnetometer used was a Bartington® Grad-601 single axis magnetic gradiometer. This specific instrument consists of a dual head array of two individual magnetic gradiometers, which simultaneously record measurements during a magnetic survey, effectively cutting survey time in half. Each of these sensors is connected to a DL601 Data Logger that stores and organizes all of the readings of magnetic variance into a file, which can be subsequently translated into a two-dimensional map.

Geophysics at Angel Mounds and the Wider Mississippian World

Angel Mounds is an appropriate place to continue the use of magnetometry as an archaeological prospecting and landscape analysis tool. In 1962, Glenn Black and Richard Johnston performed one of the earliest tests of this new technology at the site. Drawing influence from the initial tests of the technology in Europe by Aitken and colleagues in 1958, Black and Johnston wanted to test the applicability of the technology to North American soils and prehistoric archaeological features. Using a proton magnetometer, they accurately measured elevated readings of magnetic intensity across an area of Angel Mounds (specifically Subdivision P-9-D and R-8-A) where several lines of evidence, including elevation contours and a botanical survey, pointed towards the presence of a section of one of the iterations of the palisade wall and an associated bastion (Black and Johnston 1962). Although the specific type of magnetometer that was used (proton precision) has been much improved upon since this time, the methodology of survey is almost exactly the same, if not much slower, than methods of survey today. Black and Johnston's success in utilizing this technological innovation in archaeological research at Angel Mounds opened the door for the use of magnetic surveys there and across North America.

In his 1999 Ph.D. dissertation, Stephen Ball again tested the applicability of magnetometry at Angel Mounds, as well as several other types of pre-Contact sites in Eastern North America. He also includes other geophysical techniques in his survey, including electrical resistivity and conductivity, adding additional geophysical investigation potential to Angel Mounds. While the overall goal of this research was to test the capabilities of multiple geophysical remote sensing platforms at multiple site types, an additional goal of the survey for Angel Mounds was to begin expanding upon 1) the lack of knowledge of intra-site variation in population densities and 2) spatial distinctions in site usage and activity patterns, something that was woefully lacking from Black's focused excavations on the East Village and Mound F (Ball 1999). Ball utilized equipment for his magnetic survey that was far superior to that of Black and Johnston, a Geoscan FM36 fluxgate gradiometer. The innovation of fluxgate gradiometery allows for measurements not only of localized magnetic field strength affected by subsurface anomalies, as the proton precision magnetometer does, but also can simultaneously compare this reading to a 'control' reading of the broader magnetic field of the area. This concurrent comparison corrects for daily fluctuations within the earth's magnetic field, a drawback of the initial technology that Black and Johnston noted in their original tests (Black and Johnston 1962). Similar to Black and Johnston, Ball focused his investigations on a section of the palisade wall, this time a portion of the inner palisade that was located near Mound C, as well as on Mound C itself. Ball noted several advantages of Angel Mounds that lent itself to geophysical survey, including the Mississippian use of wattle-and-daub and wall trench architecture.

Building upon Ball's investigations and continuing to confront the poor understanding of population size and the spatial distribution of people and activity areas, Staffan Peterson surveyed a majority of Angel Mounds using mainly a Geoscan FM36 fluxgate gradiometer, but also a dual-head Bartington Grad-601 fluxgate gradiometer. He approached the survey within the theoretical framework of townscape archaeology, seeking to analyze Angel Mounds as a whole and understand distributions of people and activity areas in both space and time (Peterson 2010). Ultimately, he was able to identify a large number of magnetic anomalies. Between 2005 and 2009, some anomalies were identified through selective ground truthing as burnt Mississippian wattle-and-daub wall trench houses, though other anomalies hypothesized to be structures turned out to be smaller, isolated features, such as exterior hearths or fire pits. The "domestic" anomalies were grouped non-uniformly across the site in a way that Peterson was able to assign certain groupings as 'neighborhoods' (Peterson 2010). Peterson acknowledges that there is a problem with creating structure and population estimates from the presence and counts of magnetic anomalies. Within his survey, the majority of the anomalies that were noted were correlated with burnt houses (based on the limited ground truthing of a few anomalies). While many Mississippian houses likely burned due to their wattle-and-daub construction and interior hearths, by no means would all of them have, and these would leave different magnetic signatures than the burnt houses. The palimpsest of overlapping structures that is present in a high-density zone of occupation is also not readily apparent within a relatively coarse magnetic survey. Despite these limitations, magnetic survey has provided more information about the spatial distribution of activity and people at Angel Mounds than any previous method.

Magnetometry has also been used effectively as an investigative research tool across the wider Mississippian world. While the scope of recent investigations at Mississippian sites using magnetometry is too broad to cover in this setting, examples of this work are featured in recent issues of *Southeastern Archaeology*, which focus on geophysical investigations. One issue in particular focuses on Mississippian sites and has a special thematic section entitled *Geophysical Investigations of Late Prehistoric Sites Part 2: Mississippian Centers*. The articles within this section are entitled *Geophysical Survey of Complex Deposits at Ramey Field, Cahokia* (Hargrave 2011), *A New Look at Kincaid: Magnetic Survey of a Large Mississippian Town* (Butler, et al. 2011), *Recent Geophysical Investigations and New Interpretations of Etowah's Palisade* (Bigman, et al. 2011), and *A Town at the Crossroads: Site-Wide Gradiometry Surveying and Mapping at Old Town Ridge Site (3CG41) in Northeastern Arkansas* (Lockhart, et al. 2011).

Magnetic gradiometry is used in a variety of ways in these articles. Because of the potential for a large coverage area, one research goal is often the creation of large plan views that contribute to a "a more nuanced understanding of a site's overall settlement plan, particularly the distribution of subsurface defensive, residential, and public or ritual facilities relative to plazas and mounds that are visible on the surface" (Hargrave 2011:1). In addition, the high spatial resolution of magnetic gradient surveys enables the identification of potential areas for much more targeted excavation than is possible without geophysical survey, minimizing destruction of a site, while maximizing potential information gain. At Old Town Ridge (3CG41), both of these goals have been combined to map what has previously been unknown about the site because of landowner resistance to excavation, allowing research to continue without ground disturbance while providing persuasive reasoning and guidance for potential future excavations (Lockhart, et al. 2011). In many of the articles, the purposes of these targeted excavations are for building chronologies, either a relative chronology based upon the stratigraphy of overlapping features and diagnostic artifacts, absolute chronologies from carbonized samples for ^{14}C dating, or a hybrid of the two. This method is frequently successful because of the inherent magnetic properties of burned organic material and burnt earth.

In the article entitled *A New Look at Kincaid: Magnetic Survey of a Large Mississippian Town* (Butler, et al. 2011), the size of habitation areas and number of palisade walls present at Kincaid, a large Mississippian mound center, were increased significantly beyond many previous estimations. This has great effects on interpretations of population estimation, population density, site longevity, labor organization, sociopolitical hierarchy models, and more. Another interesting finding was when the palisade identified by magnetic survey was compared with excavations in an outlying mound that had produced a reliable ^{14}C chronology; it was found that the mound would have been outside of the palisade wall during its use life, casting a new light on interpretations of the role that the mound served at Kincaid (Butler, et al. 2011). Conversely, a gradiometer survey of Etowah's palisade was used to try and confirm hypotheses made from prior excavation about the scope and function of the palisade wall. The magnetic survey shows a marked lack of regularity in bastion placement and spacing, changing ideas about Etowah's palisade functions (Bigman, et al. 2011). The Etowah survey was also limited by modern magnetic disturbances, showing one of the limitations of the technology.

The goals within recent work using magnetometry at Mississippian sites are shared with those of this project. While a nearly complete site-wide map has already been created (Peterson 2010), this project builds upon the creation of this by expanding upon the site map with additional magnetic survey of the surrounding landscape. This builds upon one of the goals of this project to expand notions of site boundaries beyond the palisade wall. Additionally, and similar to the magnetic survey at Etowah (Bigman, et al. 2011), the magnetic survey outside the palisade allows us to rethink the function of the palisade itself and provides an additional spatial dataset for comparison with the magnetic survey of the site proper. This spatial comparison was one of the originally stated goals of the project, although it did not manifest itself in a way that was expected.

Chapter Six - Materials and Methods

Methodologically, there were several approaches to gathering data on the occupation of the 3rd Terrace at Angel Mounds – magnetic geophysical survey, shovel test survey, and reanalysis of a legacy collection. These all contributed to the larger goals of current research at Angel Mounds. Magnetic survey of areas outside of the palisade builds upon previous surveys of the site, while addressing issues of meaning and conception of the palisade itself. Shovel test survey builds upon what is known about the distribution of cultural material on the 3rd Terrace, while also attempting to identify artifacts consistent with that of a presumed Woodland period occupation associated with Mound G, as well as those of the Mississippian occupation of Angel Mounds. A reanalysis of the 3rd Terrace legacy collection utilizes already excavated material from Angel Mounds, which may also contribute to our understanding of Mississippian conceptions of the palisade wall. Additionally, this reanalysis improves our understanding of the first excavations performed by Glenn Black at Angel Mounds in 1939. All of these combined contribute much to our understanding of the landscape surrounding Angel Mounds.

Magnetometry

The main component of the investigation was the magnetic gradiometer survey of roughly 7.83 hectares (19.35 acres) between the palisade wall of Angel Mounds and Mound G, roughly 500 meters to the northeast (see Figure 3.1). A grid composed of 30 x 30 meter grid blocks was laid over the survey area (see Figure 6.1). This grid utilized the coordinate system created by the Glenn A. Black Laboratory of Archaeology for

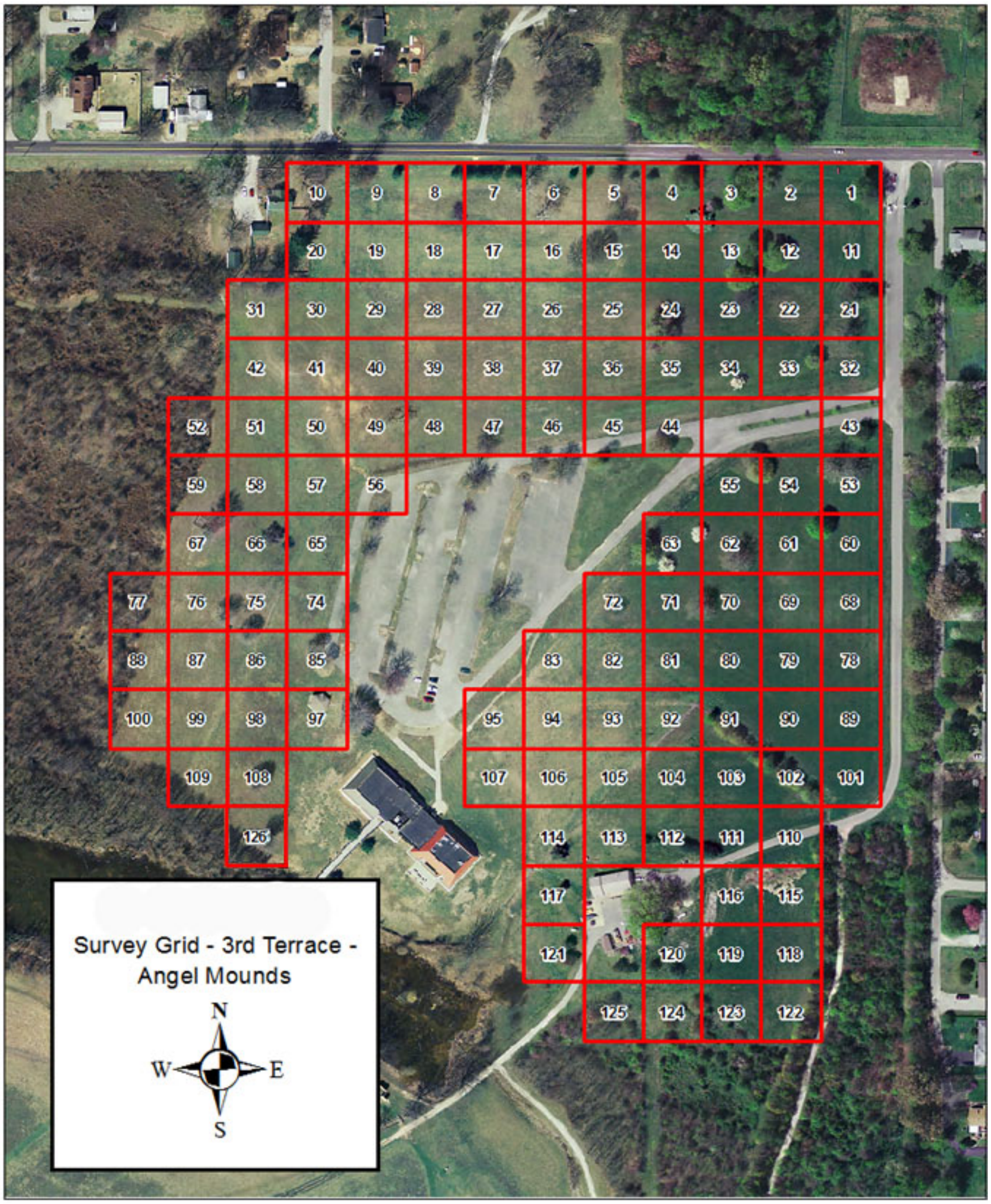

Figure 6.1: 2011/2012, 3rd Terrace survey area (30 x 30 m grids)

research at Angel Mounds State Historic Site. This coordinate system is based on the original grid system used by Glenn Black in the initial WPA era excavations of the site beginning in 1939. The southwest corners of each 30 x 30 meter grid block were used to tie the grid into the coordinate system. A total of 126 grid blocks with the potential to be surveyed were identified and numbered (see Figure 6.2 for the final survey grid).

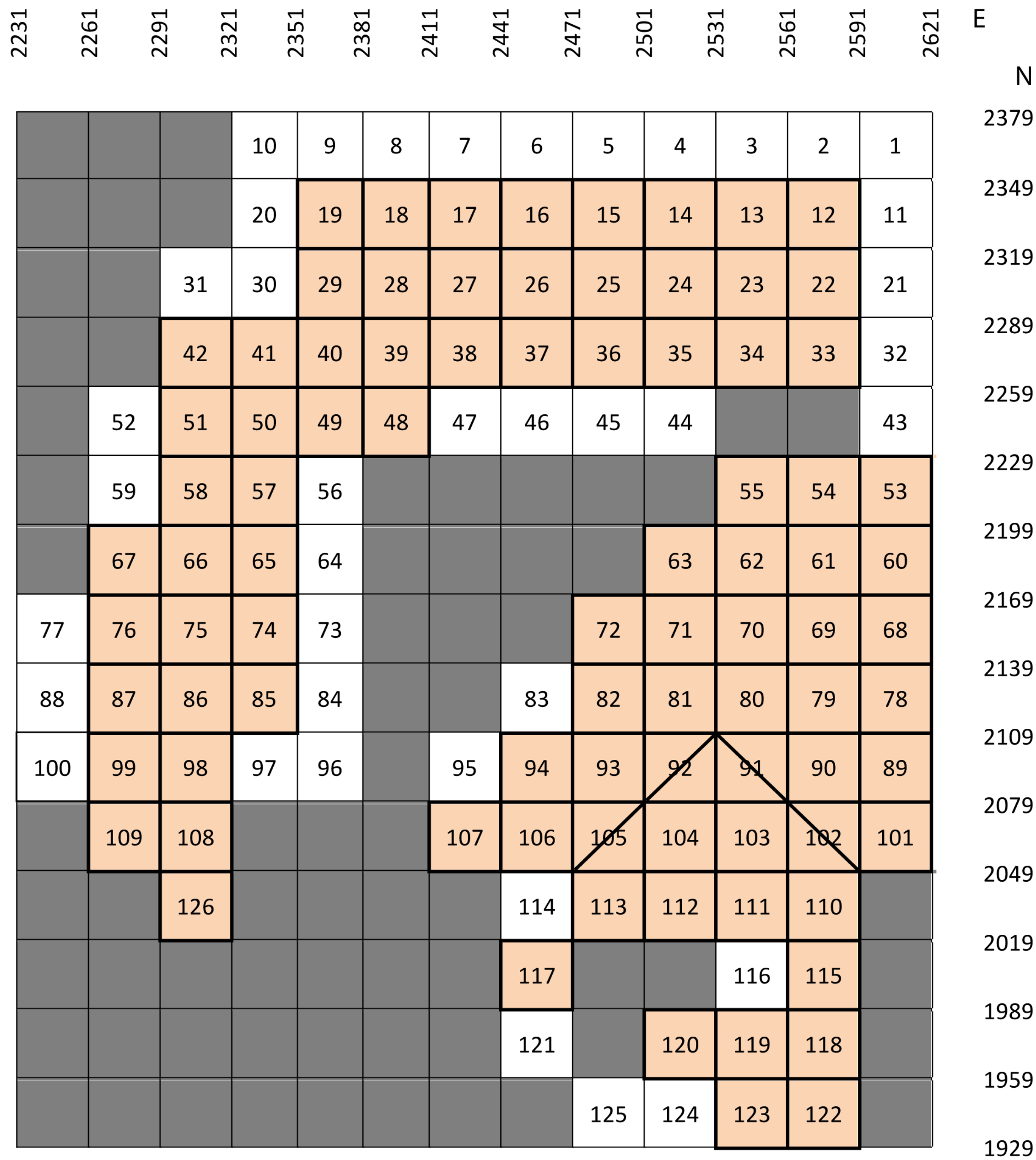

Figure 6.2: Completed Survey Grid Blocks with Corner Coordinates

Physically, the grid was laid out using a Leica TPS1100 Total Station for absolute reference points at several points across the field. The remaining corner points were manually triangulated using 100-meter tape measures. All grid corners not placed using the Total Station were subsequently recorded to create a complete digital record of the grid coordinates. Accuracy was checked against a digitally produced hypothetical grid and the actual ground coordinates. Variation never exceeded 10 cm – well under the finest spatial resolution possible with the magnetometer. A Bartington Grad 601 Single Axis Magnetic Gradiometer was then used to conduct the magnetometer survey at 50 cm transect intervals, recording eight readings of magnetic field variation per linear meter (every 12.5 cm). Transect lines within grid blocks were oriented North-South and were begun in the southwest corner unless otherwise necessary due to obstacles. Areas of potential magnetic anomalies were resurveyed at 25 cm intervals, again at eight readings per linear meter (one every 12.5 cm), to provide an image of greater spatial resolution.

The Grad601 Magnetometer is produced by Bartington Instruments of the United Kingdom. It is composed of a pair of cylindrical fluxgate gradiometers (Grad-01-1000L) with a one-meter horizontal separation between gradiometers and a one-meter vertical separation between the individual fluxgate magnetometers within each gradiometer. This allows for each individual gradiometer to continually adjust for variability in the global magnetic field due to diurnal fluctuation and eliminates the need for a separate base station to record fluctuations for post-collection processing of the data. The magnetometer was adjusted prior to each day of the survey to balance the individual gradiometers for consistency in the data collected. This was performed in a pre-determined, magnetically neutral location to also maintain data consistency. The Bartington Data Logger (DL601) records all measurements of the magnetic field as a series of individual measurements and organizes them based upon preset parameters for how the survey is conducted. For the Angel Mounds 3rd Terrace survey, a zig-zag pattern (ideally starting in the Southwest corner and ending in the Northeast) was used to collect data, as it was much more time efficient and cut collection times in half compared with a Parallel collection pattern. The range was set to ±100 nT with a resolution of 0.03 nT, which was the setting with the finest spectral resolution that allowed for distinguishing the finest details of magnetic variation.

Transects of 50 cm separation were chosen to attempt to balance the limited amount of time that was available to survey with the ability to detect smaller anomalies in the landscape. Theoretically, any anomaly that produces a signature of at least 50 cm diameter when measured on its smallest axis in a two-dimensional planar view will be detected by at least two transects that have a 50 cm separation. It must be remembered that the size of the magnetic anomaly does not directly correlate with the size of the object or feature it represents, but rather it is the strength of the magnetic signature that is inherent to it. Therefore, a small iron nail will be detected as a relatively larger anomaly while a concentration of magnetically charged topsoil (as in a filled pit feature) will be detected as relatively smaller (see Figure 6.3). In Figure 6.3, anomalies labeled with blue arrows are dipoles for which their source are likely the size of nails, and anomalies with red arrows are monopoles for which their source is likely close to the same size as the anomaly, in this case roughly 1-3 meters in diameter. For the goals of this survey, which was the investigation of potential structures and larger features such as pit features, Mississippian pit houses, and palisade walls, a 50 cm transect width seemed adequate to detect even the smallest of these anomalies. Anomalies that were thought to be of cultural significance were resurveyed at a 25 cm

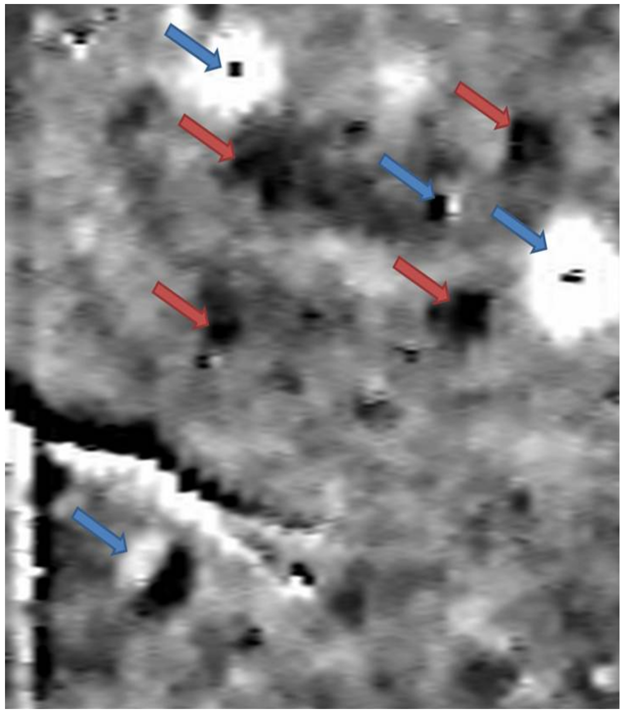

Figure 6.3: Examples of monopolar (red arrows) and dipolar (blue arrows) magnetic anomalies

transect separation and eight readings per linear meter, which is the finest spatial resolution capable on the Bartington Grad601.

All data gathered through the use of the Bartington Magnetometer were processed using ArcheoSurveyor (made by DW Consulting Geophysical Data Services). The processing techniques used to enhance the data were designed to remove ancillary data and provide a clearer picture of any underlying features that may be present. This included clipping out the extreme high and low values to focus on the relatively minor variations in the magnetic field, which can be associated with Pre-Columbian cultural features. Datasets were also de-staggered to account for any slight user error in the timing of collecting a grid block. De-striping was also utilized to lessen the inconsistencies in data collection from average higher or lower values from one sensor relative to the other, such as instances of one sensor collecting data at a slightly higher elevation than the second. A de-spiking function was used to smooth any spikes in the data and the overall image was smoothed to provide a cleaner picture of potential anomalies (see Figure 6.4 (a), (b), (c), & (d) for pre and post processing examples). With each processing function that was performed, a check of the data that had been removed was conducted to determine if any potential features were accidentally "processed away" and the function was reversed if there was any doubt about the retention of all potential features.

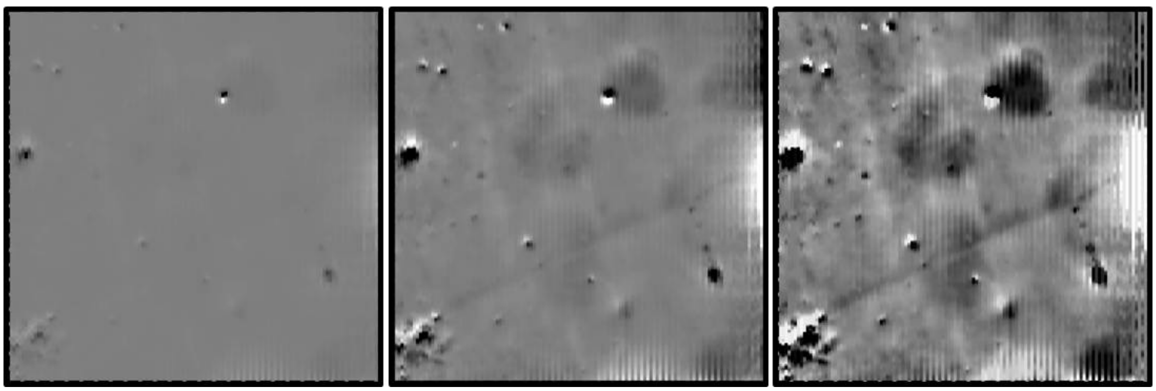

Figure 6.4 (a): Clip Function - No Clip → ±50 nT Clip →±10 nT Clip

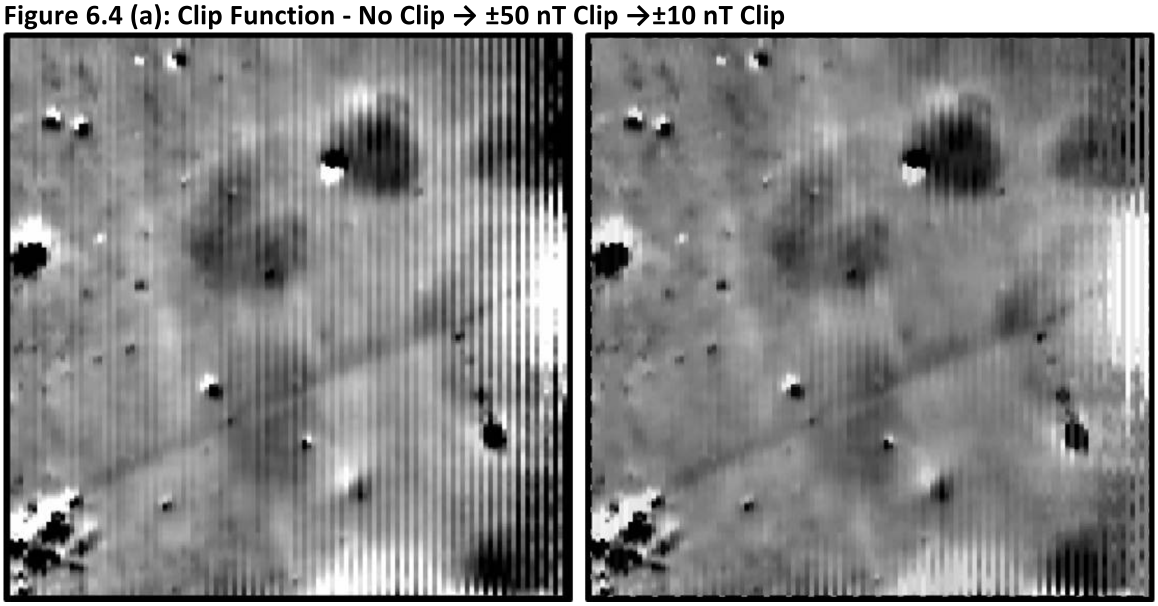

Figure 6.4 (b): Destipe Function – Before and After

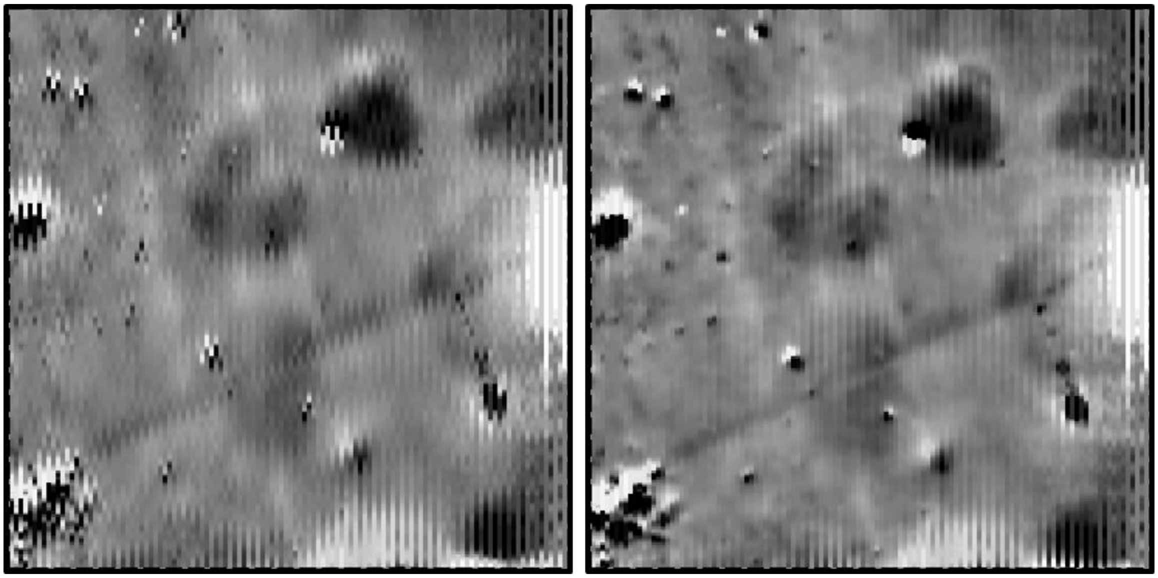

Figure 6.4 (c): Destagger Function – Before and After

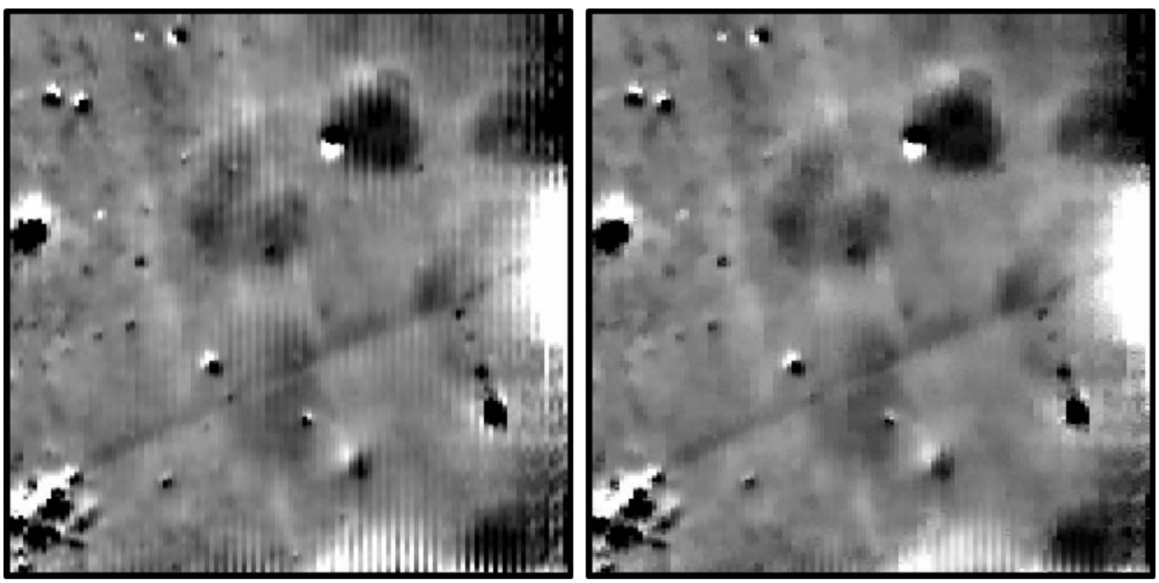

Figure 6.4 (d): Despike Function – Before and After

Shovel Testing

Areas of magnetic anomaly that were suspected of containing cultural features were shovel tested with 30 cm diameter round STPs at 15-meter and five-meter intervals depending on the dimensions of the anomaly being tested. In addition, accessible areas surrounding Black's 1939 3rd Terrace excavation were shovel tested as well. All excavated soil was screened using shaker screens with ¼ inch screen. Some artifact classes were noted on the STP forms and discarded on site, including large brick fragments, coal slag, and plastic. The soil profile of each shovel test was recorded and all shovel test pits were excavated at least 10 cm below the B Horizon unless the STP reached an unworkable depth for spades (roughly 1 meter) or an obstacle such as a tree root was encountered. Depths and consistencies of soils potentially congruent with anomalies were also investigated using soil probes. All material culture recovered from the shovel test pit survey has been curated at the Glenn A. Black Laboratory of Archaeology (see Figure 6.5 for a map of STP placement).

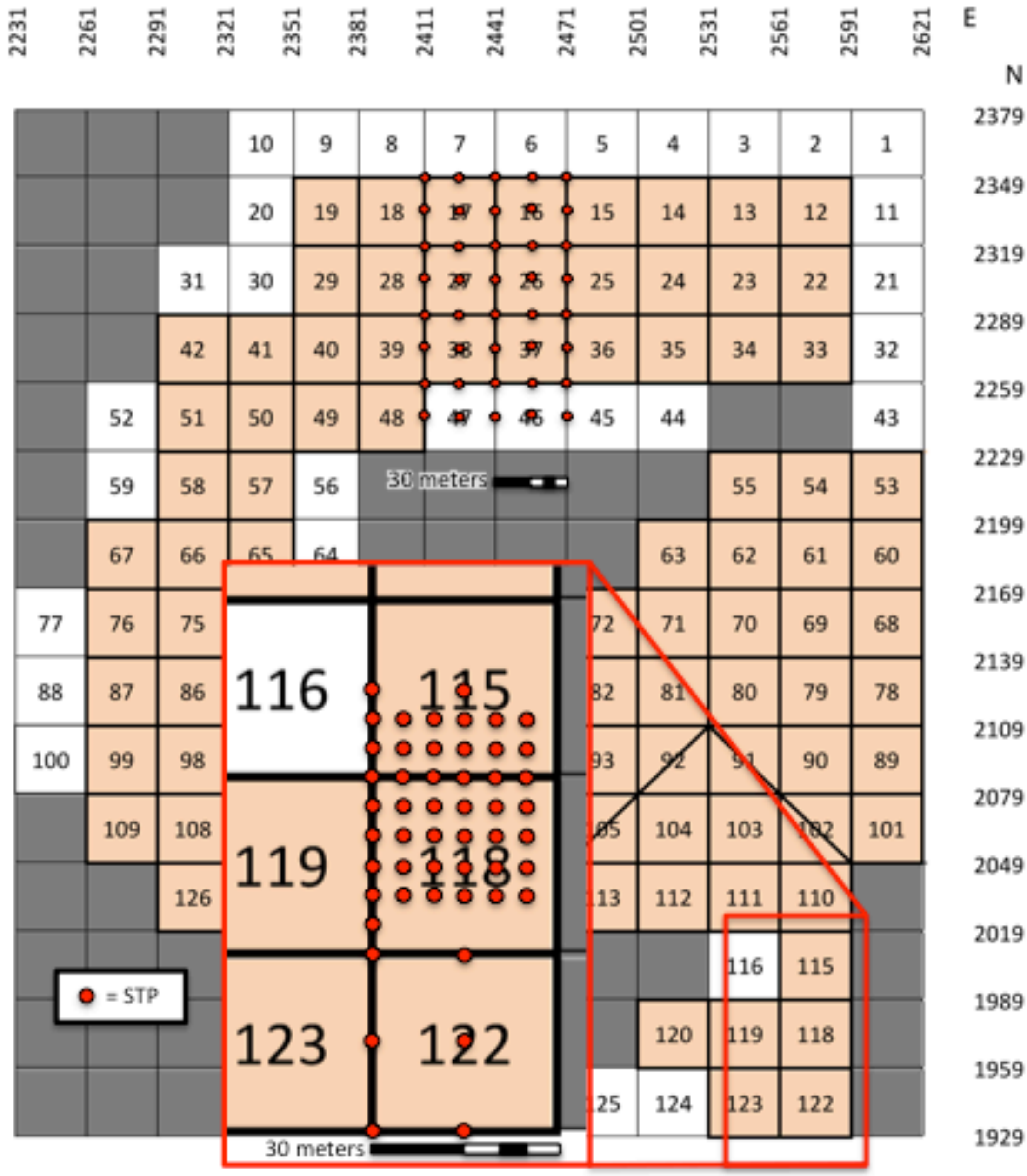

Figure 6.5: 2011 Shovel Test Survey

The Third Terrace

In addition to the geophysical and shovel test surveys, a reexamination of Glenn Black's initial excavations on the landform was conducted as well. Glenn Black and his initial WPA crew excavated an area encompassing over 7,500 square feet (roughly 700 square meters) in 1939 as training for the planned excavations on the Angel Mounds site proper (Black 1967). An examination of the Field Site Log and Artifact Logs from the excavation, as well as the catalogue from the Glenn A. Black Lab was conducted and ceramics from the excavation were reexamined. These ceramics have the potential to be statistically compared with ceramics from the site proper for differences in proportions of vessel form, vessel type, and stylistic markers. Data gathered by Sherri Hilgeman for her Doctoral Dissertation and subsequent publication (Hilgeman 2000) were used as the population parameters to test the 3rd Terrace ceramic sample against.

The process of reanalyzing the collection consisted mainly of obtaining accurate weights of individual bags. After double-checking the counts that were written on the bags for a number of them, it was determined that they were usually accurate and any discrepancy was likely the result of degradation and breakage of the artifacts since they had been counted and, therefore, the original counts would likely be more accurate. Rim sherds and textile-impressed sherds were more often than not contained within each bag, separated out into smaller bags. These were counted and weighed separately as well. Each bag was opened prior to weighing and the contents were examined. Any non-ceramic material was removed, the counts were adjusted, and any stray sherds that were not plainware (usually smaller rim sherds or textile impressed sherds) were redeposited in their respective bags. Occasionally, and most importantly, some sherds were located that appeared to have been missed during the original processing and could be assigned a ceramic type. While fault cannot be placed on the original WPA processors for missing some, since at that time many of these types were undefined, it does call into question some of the total counts of the ceramic types recorded for Angel Mounds based solely on the catalogue and what had been previously processed.

The analysis of the ceramic component of the 3rd Terrace collection involved identification of vessel type based upon rim sherd morphology, as well as any body sherds that displayed enough significant morphological characteristics to assign a vessel type. The basis for this analysis is a journal article entitled *Big Pots for Big Shots: Feasting and Storage in a Mississippian Community* (Blitz 1993). The methodological framework for his study was to examine categories such as distributions of decorated types, ware categories, and vessel shapes to infer differences in food consumption activities between a mound context ceramic assemblage and a village context assemblage. The factor that ended up being a significant indicator of these differences was range in vessel orifice size. Ceramics from mound contexts were typically of a restricted range, but on the larger end of the scale, while the village context encompassed a wide variability in vessel size. He attributes this phenomenon as being indicative of feasting activities, which act as a signifier and solidifier of power in those controlling the feasting and, consequently, the mound (Blitz 1993).

While there are several differences between the situation in Blitz's study and that of Angel Mounds, the potential to learn about some of the functions and purposes of the 3rd Terrace in relation to the main site are present. The basis of Blitz's study as it relates to the 3rd Terrace is that daily, domestic life creates a wide and varying range of vessel types, sizes, and forms to fit the needs of any number of the tasks of daily life. Assemblages that show restricted ranges in any attribute of ceramic vessels could potentially point towards specialization in use of a site and a departure from the assumption of a 'normal' domestic space. By estimating vessel form and size from the 3rd Terrace ceramics, a statistical comparison can then be made between these and Mound F, an East Village sample, and Angel Mounds as a whole to determine differences in variability of ceramic vessels. This can then potentially be related back to any number of the potential causes of these disproportionate collections mentioned earlier.

As a preliminary test of this hypothesis, the few measurements of vessel orifice that have previously been obtained by Hilgeman from the 3rd Terrace were compared to measurements of vessel orifice from the context of Mound F, the previously mentioned Subdivision W-10-D (in the East Village), and to the site as a whole. The data set was divided by vessel form into bowls, plates, and jars. Bottles (which are typified by small vessel orifices and restricted necks) were not included because it has been shown that orifice size of bottles does not significantly correlate with overall vessel size (Blitz 1993). At this time, any statistical test run would be considered statistically weak because of the small sample size from the 3rd Terrace (2 bowls, 3 jars, and 2 plates). However, there are potentially some trends that may become more statistically valid as additional vessel dimensions are determined. As can be seen in Table 6.1, Hilgeman's previously examined samples from the 3rd Terrace consistently have a smaller mean orifice diameter than Mound F and W-10-D, as well as Angel Mounds as a whole.

Table 6.1: Mean Orifice Diameter – Vessel Types from Four Angel Mounds Locations

Vessel	Area		#	Mean	Std. Dev.
Bowl	3rd Terrace	Diameter	2	130.00	70.711
	Angel Mounds	Diameter	354	203.31	69.771
	Mound F	Diameter	8	167.50	61.354
	W-10-D	Diameter	58	191.83	78.904
Jar	3rd Terrace	Diameter	3	128.33	10.408
	Angel Mounds	Diameter	605	224.90	86.807
	Mound F	Diameter	4	205.00	57.446
	W-10-D	Diameter	125	223.80	86.748
Plate	3rd Terrace	Diameter	2	300.00	28.284
	Angel Mounds	Diameter	983	319.93	32.570
	Mound F	Diameter	69	322.03	39.280
	W-10-D	Diameter	223	323.50	30.966

In addition to the quantification of the 3rd Terrace ceramic materials, a random sample of rim sherds were identified to test the statistical correlation between 3rd Terrace ceramics and those from the East Village, Mound F, and the large site. Any FS that was determined to contain rim sherds was considered for the random sample. Because accurate counts and weights had been obtained earlier, those rim sherds with an insufficient weight were not included in the random sample. The reasoning for excluding these is that a minimum arc of 10 degrees of the circumference of the vessel rim is necessary to adequately and reliably measure vessel diameter (Blitz 1993:87).

Based on observation during the initial sorting and weighing of the collection, it was determined that individual sherds with a typical weight of less than 5 grams did not contain a sufficient arc to determine vessel orifice diameter and these were excluded from the random sample. Because the analysis had been based upon the FS numbers and not individual sherds, there was a wide range of potential rim sherds within these FS numbers, ranging from one up to 34 individual rim sherds in any given FS. Random numbers between zero and one were assigned to each FS and the list of potential rim sherd FS numbers to analyze was organized by their random numbers. When divided into four equal potential samples, a roughly equal amount of individual rim sherds by both count and weight were contained within the four subdivisions.

Beginning with the first quarter of the list, individual FS numbers were reopened and reanalyzed to assess their potential to yield enough detailed information on vessel orifice diameter. Individual rim sherds were measured using a ceramic diameter chart if their arc was greater than 10 degrees. This process continued until 50% of the potential rim sherd FS numbers had been analyzed. When the already measured sherds from Hilgeman (Hilgeman 2000) were included, this resulted in a sample size of 34 individual sherds that were measured for vessel orifice diameter, creating a statistically reliable sample. Because bottles have not been shown to exhibit the same correlation between vessel orifice diameter and vessel size (Blitz 1993), any sherd that was determined to be from a bottle was eliminated, leaving a sample of 30 sherds. An additional 50% of the potential rim sherds to be analyzed remained, leaving the potential for a statistically more rigorous comparison in the future beyond this initial assessment of the ceramic component of the collection. Results of this analysis will follow in Chapter Seven.

Additionally, in an attempt to assign the 3rd Terrace an absolute, chronometric date in relation to the other dates obtained from Angel Mounds, potential samples were identified in the legacy collection that could be used for radioisotopic Carbon-14 (radiocarbon) dating. Although there were numerous potential samples, they were narrowed down using the criteria of sample size, spatial relation to identified features, and temporal span (including lifespan and potential use life of the sample). Among this subset of potential samples were paleoethnobotanical samples that were identified as wood from Hickory (*Carya sp.*) and a stem from River Cane (*Arundinaria gigantea*). Dr. Leslie Bush of Macrobotanical Analysis performed an identification of the paleoethnobotanical samples. Additionally, a cache of faunal material was identified in Feature 6 / Y-8-B of Block 8-R-1, a pit feature identified by Black during excavation. Matthew Rowe of the William R. Adams Zooarchaeology Laboratory at Indiana University conducted a faunal analysis on these remains. These were identified as primarily White Tail Deer (*Odocoileus virginianus*) with one Fox Squirrel (*Sciurus niger*) femur as well. Results of the paleoethnobotanical and the limited faunal analyses in regards to their C-14 sampling potential will be discussed in Chapter Seven.

Chapter Seven - Results

Magnetometry Survey

The bulk of the magnetometry survey was completed during the 2011 GBL and IUPUI field school from early May until mid-June, during a span of six weeks. Much of the beginning portions of the field season were spent learning the intricacies of the Bartington Magnetometer and developing standardized field practices that would allow for a consistency in methodology throughout the survey. Trial runs with the magnetometer were conducted on a portion of the main site where the 2011 field school students had projected (correctly) that a bastion from the palisade wall would be located. Initially, the research proposal had called for 20 x 20 meter grid squares in order to fit more complete grid squares into the survey area. However, after conducting these field tests and consulting with Dr. Michael Strezewski of the University of Southern Indiana on the capabilities of the magnetometer, it was determined that the most effective survey method would be 30 x 30 meter grid squares. These larger grid blocks could then be partially filled with "dummy" data when necessary if parts of an individual grid could not be surveyed due to plant overgrowth or modern structures, such as sheds and parking lots. It was also at this point that the decision to survey at 0.5 m transects with 8 readings taken per meter was confirmed because of image clarity of the aforementioned bastion produced at this resolution. The only higher spatial resolution available on this model of magnetometer was to double the number of transects to a 25 cm transect separation. This resolution was reserved for clarification of anomalies that were detected on the 3rd Terrace.

In total for the 2011 field season, 79 30 x 30 meter grid blocks (71,100 m^2 / 7.11 hectares) were surveyed at a 0.5 m transect separation, and one 30 x 30 meter grid block (900 m^2) was surveyed at a 0.25 m transect separation. The one grid block that was surveyed at 0.25 m transects was a resurvey of a magnetic anomaly, and so does not contribute to the total area surveyed of 71,100 m^2 (7.11 hectares). Portions of this total also contain some sections of the survey area on the periphery that were overgrown or developed, although these were generally avoided and do not contribute significantly to the total. Several other areas of the survey area that are considered of higher potential to contain magnetic anomalies were unable to be surveyed at all during the 2011 field season. Several reasons contributed to this, including part of the north field being devoted to a prairie rehabilitation program where mowing was not permitted, as well as portions of the survey area being used as storage for machinery and materials used by the support staff of the Angel Mounds State Historic Site. These areas, consisting of 8 30 x 30 m grid blocks (7200 m^2, 0.72 hectares), were surveyed during the 2012 field season, contributing to the total of 87 30 x 30 meters grid blocks (78,300 m^2, 7.83 hectares) for the entire magnetic survey (see Figure 7.1).

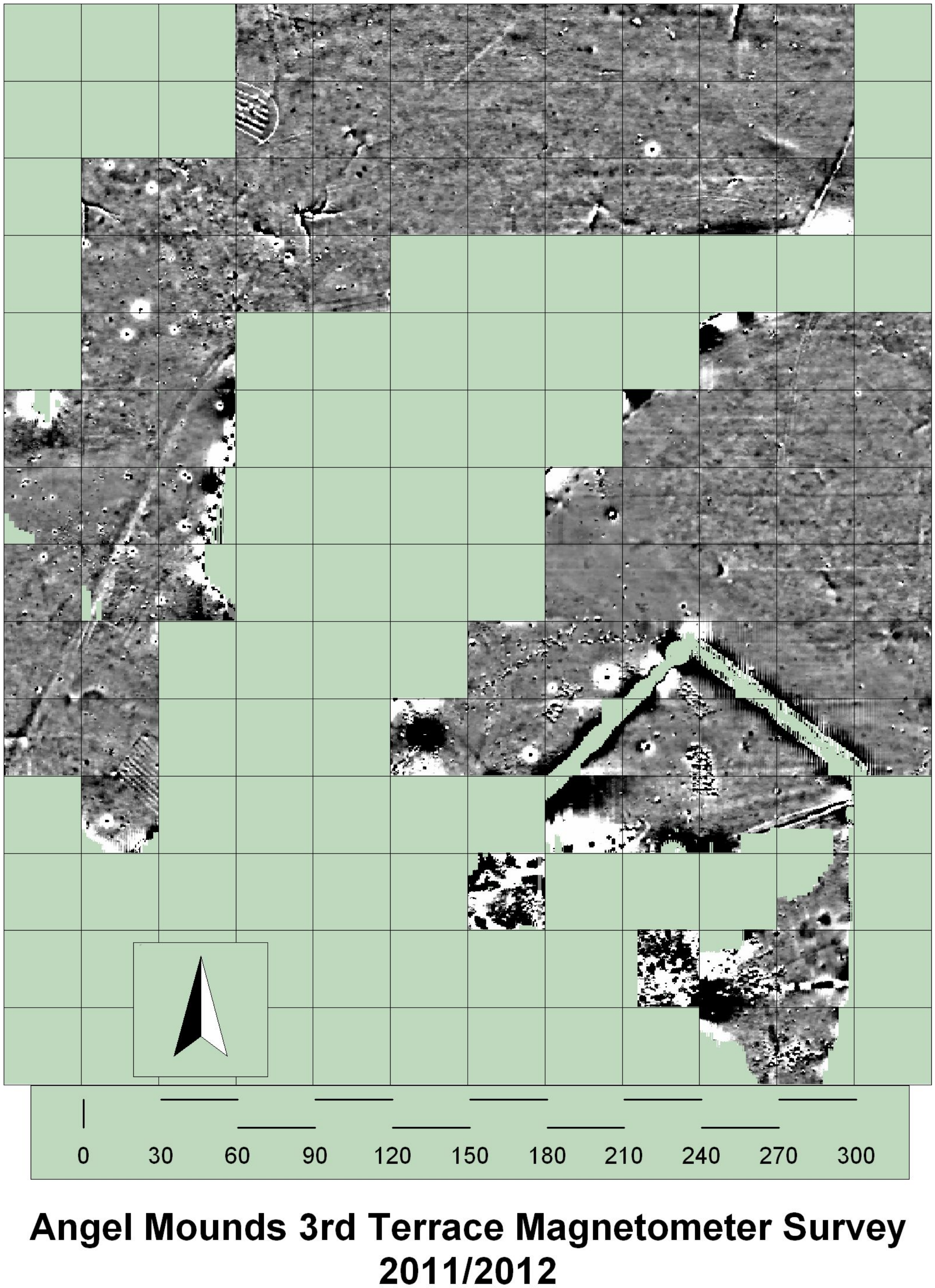

Figure 7.1: Completed Magnetometry Survey, built from 30 x 30 meter grid blocks

A number of magnetic anomalies were noted throughout the survey, many of which were rather unexpected, while the presence of others (such as a known utility pipe and septic system) confirmed the reliability and accuracy of our survey methodology. Large areas of the survey area were relatively magnetically "quiet", with magnetic readings fluctuating by only 2 or 3 nT (see Figure 7.2). Other areas had extremely high monopolar and dipolar magnetic readings, produced by many of the metallic elements of the area, including fence lines, metallic sheds, and metal borders of the parking lots. Other highly dipolar anomalies include light poles, overhead electrical lines, buried water pipes, and unknown metallic debris that have been deposited throughout the fields over the years (see Figure 7.3).

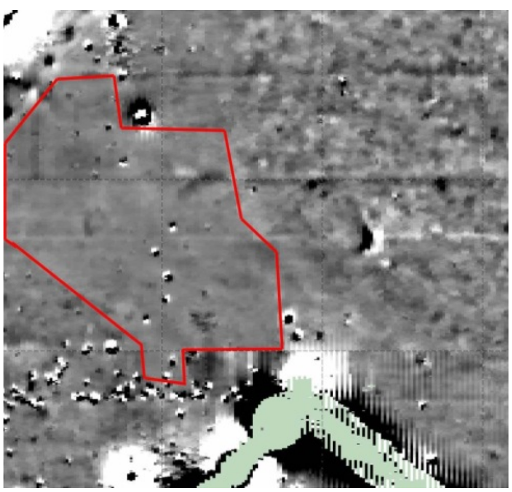

Figure 7.2: Magnetically quiet area

Image includes portions of grid blocks 70, 71, 72, 80, 81, 82, 91, 92, & 93 (see Figure 6.1 & 7.1), SE of the parking lot.

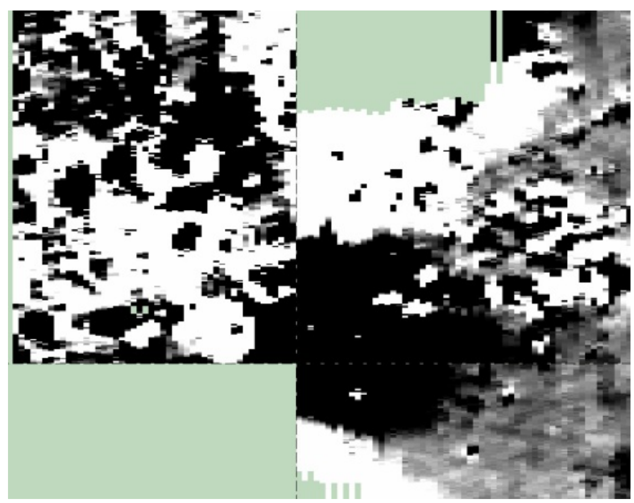

Figure 7.3: High magnetic disturbance

Image includes portions of grid blocks 119, 120, & 123 (see Figure 6.1 & 7.1) on southern edge of the survey area

For an image of an inset of the southeast potion of the survey with the location of the 1939 excavations, see Figure 7.4. A number of anomalies that were noted in the vicinity of the maintenance facility on the property appear to be remnants of structures that were present from the WPA and post WWII era (early 1940's) until they were demolished and removed sometime in the late 1970's (see Figure 7.4 (a)). These anomalies are conglomerations of many dipolar anomalies that appear in rectangular and linear fashions, consistent with a circle of barracks and support structures, as well as an old fence line from the original WPA excavation support structures (see Figure 7.5 (a) for a plan map of these structures produced by the DNR Dept. of Engineering and Figure 7.5 (b) for historic aerial imagery).

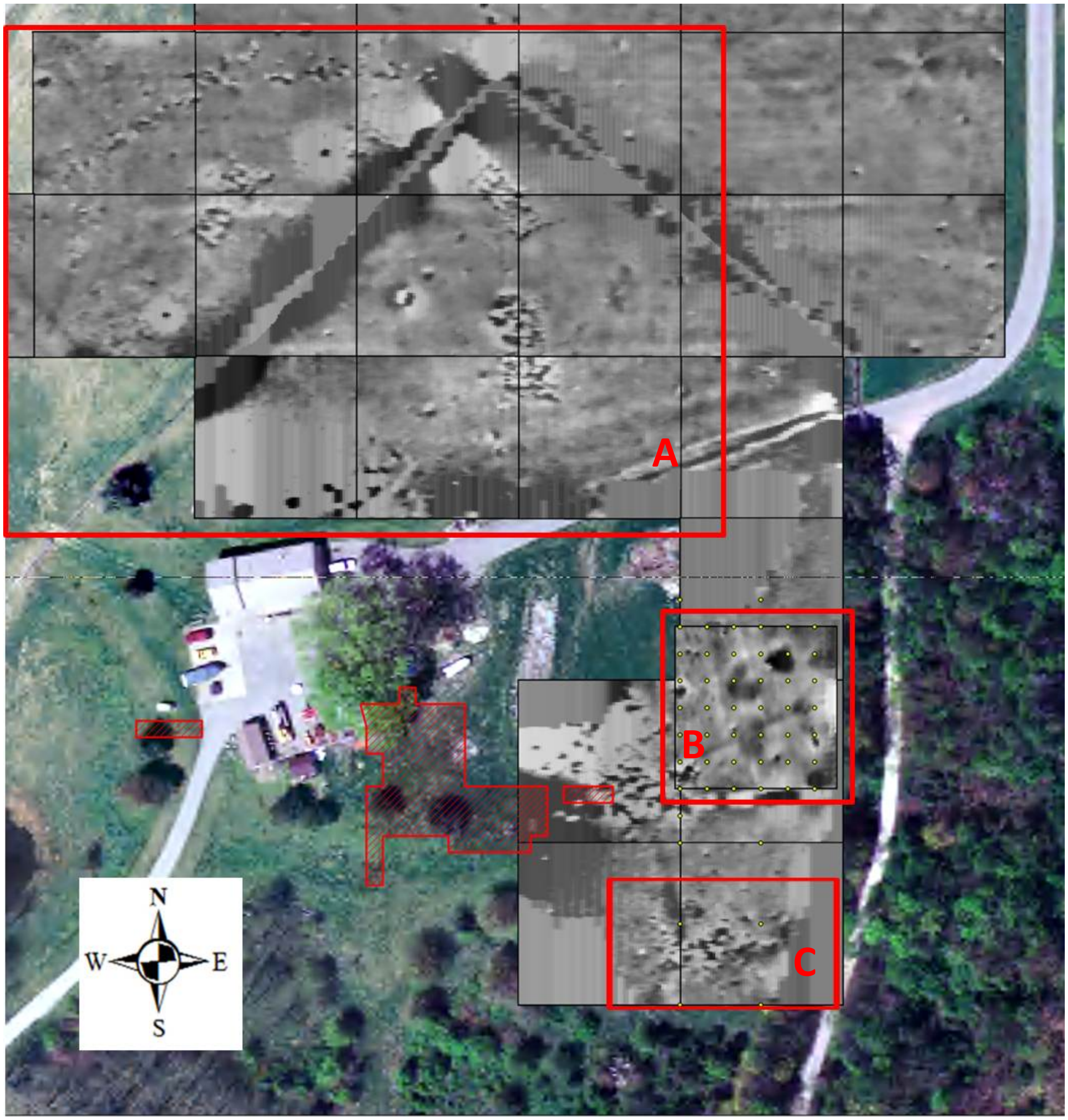

Figure 7.4: SE portion of survey area, with anomalies corresponding with IU Field School Barracks (a), potential Mississippian anomalies (b), and concentrations of dipolar anomalies (c).

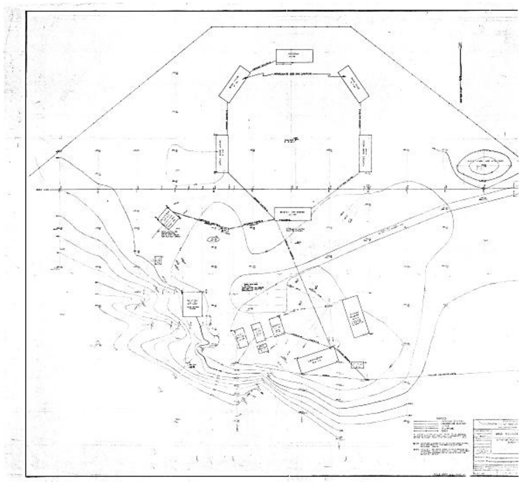

Figure 7.5 (a):

DNR Dept. of Engineering survey of IU Field School Barracks and WPA outbuildings

Figure 7.5 (b):

Aerial photograph of IU Fields School Barracks and WPA outbuildings

There are also a number of anomalies whose origin has not been determined at this time. One of the largest is a “Zig-Zag” anomaly (see Figure 7.6), which is linear in nature and cuts back and forth at roughly 90-degree angles across a large portion of the north field. It gives off a very small variation in the magnetic signature with readings varying only a few nT on average from the surrounding areas. This anomaly could be related to other, even fainter linear anomalies that were noted across the majority of the eastern portion of the survey area, running predominantly east to west. There is a similar linear anomaly that appears to parallel the entrance road to the maintenance facility (running north-south), which the other linear anomalies may relate to or meet up with (see Figure 7.7). Periodically there are other linear anomalies appearing within this network that run at a 45-degree angle as well. It has been hypothesized that these may be ceramic drainage tile that was laid for agricultural purposes when this area was a functioning agricultural field, but this has not been confirmed. One apparent difference between the “Zig-Zag” anomaly (Figure 7.6) and other linear anomalies (Figure 7.7) is their orientation. The linear anomalies (Figure 7.7) run generally along a standard cardinal axis (north-south, east-west) that is aligned with the historic built environment (i.e. – historic and modern roadways, county lines, land parcel divisions, etc.). However, when a line is fit to the general direction that the “Zig-Zag” anomaly is trending, it appears to be running NNE to SSW, tilted slightly off of the ‘historic grid’. While this does not rule out a historic provenience for the “Zig-Zag” anomaly, the etiology for this anomaly is likely different than that of other linear anomalies in the area, and may correspond to an earlier, perhaps prehistoric, modification of the landscape.

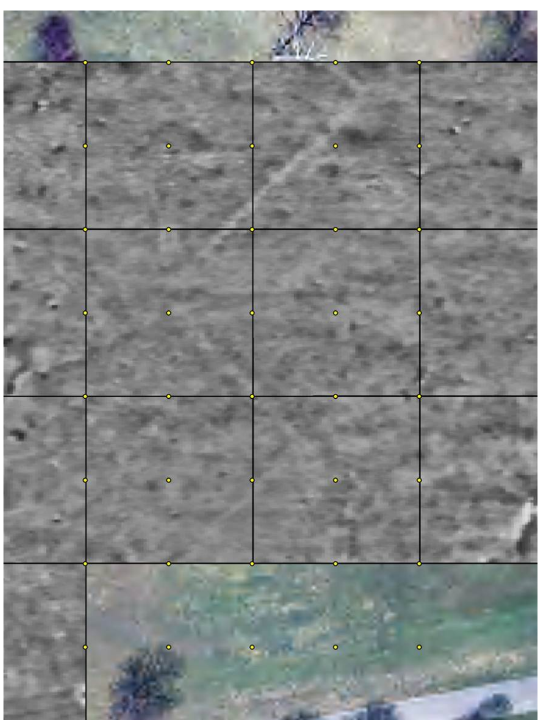

Figure 7.6:
“Zig-Zag” anomaly within grid blocks 16, 17, 26, 27, 37, & 38 (see Figure 6.1 & 7.1)

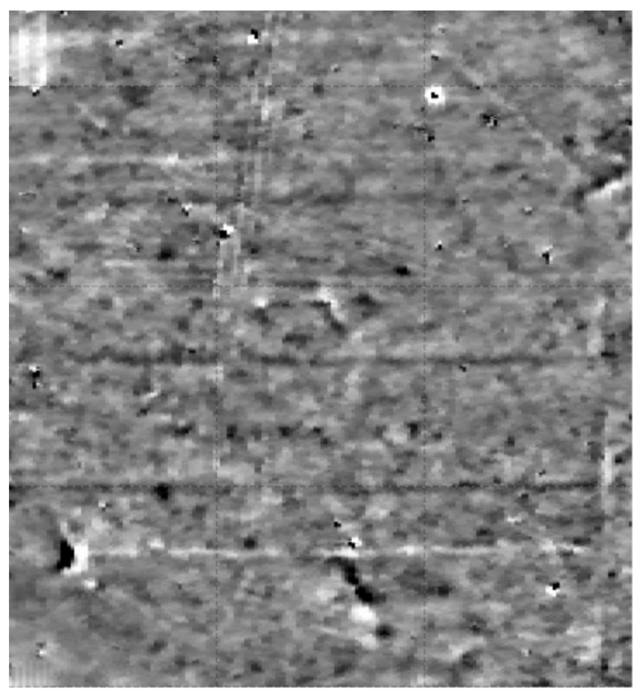

Figure 7.7
Example of linear anomalies from grid blocks 53, 54, 55, 60, 61, 62, 68, 69, 70, 78, 79, & 80 (see Figure 6.1 & 7.1) on eastern edge of survey area

The anomalies that were of greatest interest for this project were located in the far southeastern corner of the survey area, just east of where Glenn Black conducted his initial 1939 excavations on the 3rd Terrace (see Figure 7.4 (b)). These anomalies were resurveyed at a transect separation of 0.25 meters to show the greatest spatial detail possible for the Bartington Magnetometer. They consist of several (at least three and possible as many as six) rectangular to ovoid positively charged anomalies with a negatively charged border (see Figure 7.8). This magnetic signature is consistent with that shown by Staffan Peterson to represent Mississippian structures from inside the palisade wall of the main site (see Figure 7.9 for a comparative anomaly from the main site) (Peterson 2010). These anomalies range in size from roughly 3 x 3 m^2 up to roughly 7 x 10 m^2. The three that are most similar to those of Mississippian origin from the main site all are roughly from 5 x 5 m^2 to 7 x 10 m^2. Other unidentified and smaller anomalies exist throughout the survey area. They are typified as slightly more positive monopolar anomalies, which could represent a very ephemeral cultural modification of the landscape or natural variation within the magnetism of the soils in the surveyed area (see Figure 7.10 (a)). A targeted soil probe sampling strategy may help to further define several of these anomalies as cultural or natural. There are also a number of irregularly shaped linear dipolar anomalies that are of unknown origin at this time (see Figure 7.10 (b)). A similar strategy of targeted soil probe sampling may assist in further defining the nature of these anomalies.

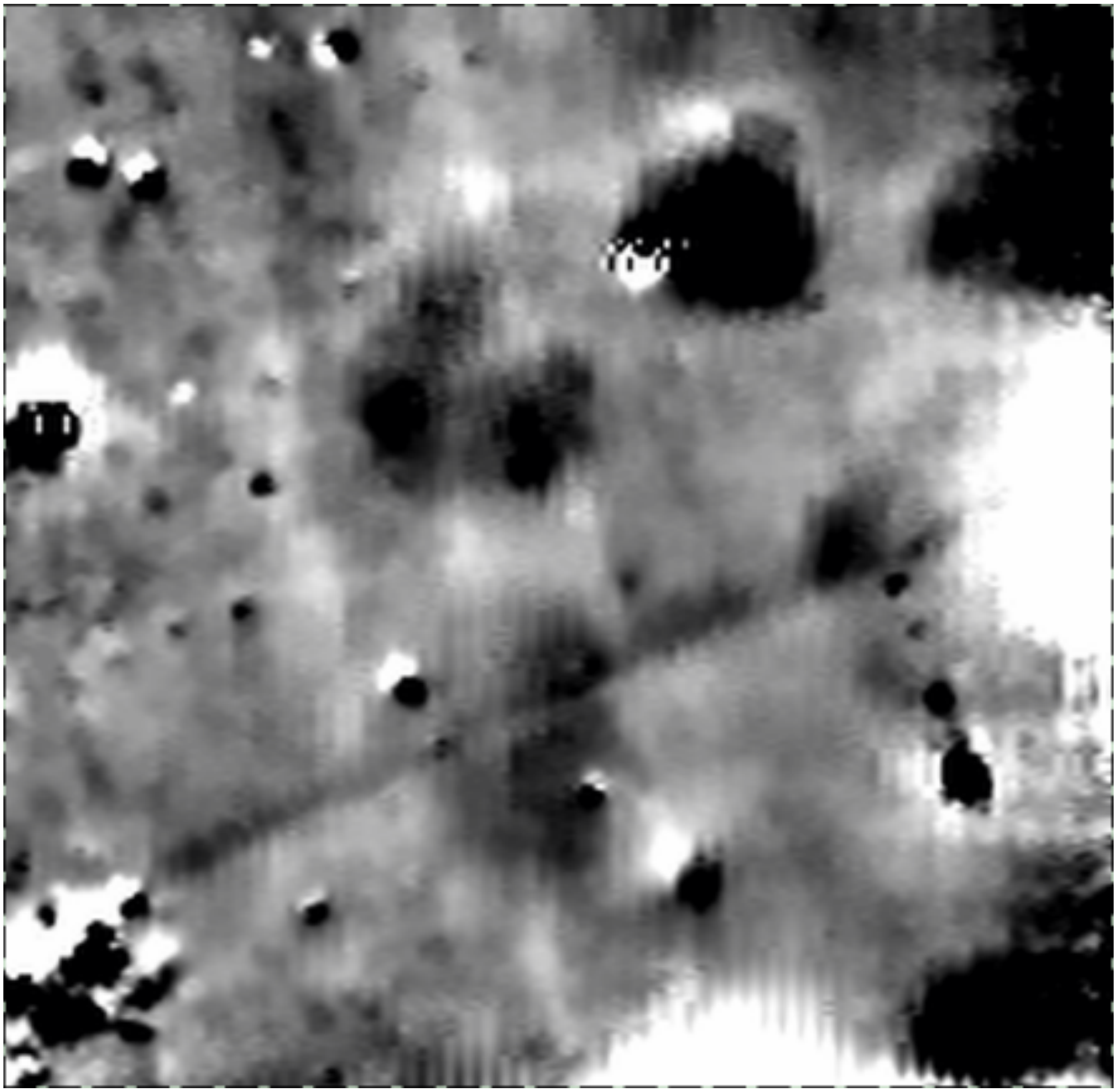

Figure 7.8: 0.25 meter resurvey of magnetic anomalies within grid blocks 115 & 118

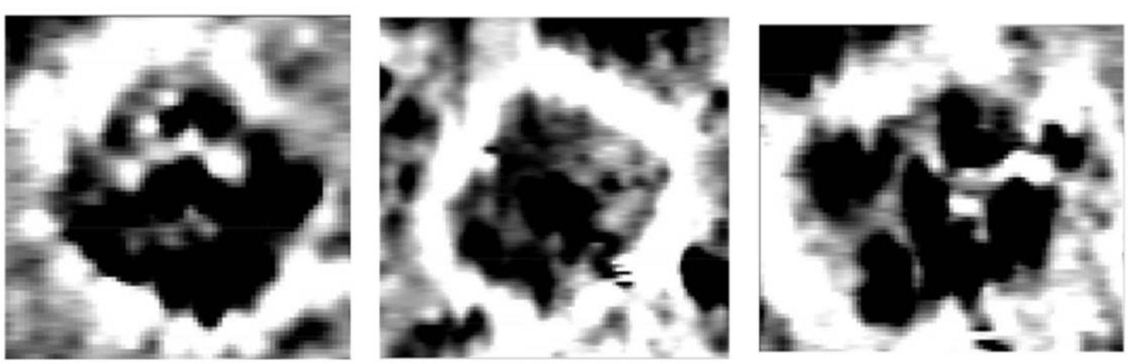

Figure 7.9: Comparative anomalies from the main Angel Mounds site (Peterson 2010:84)

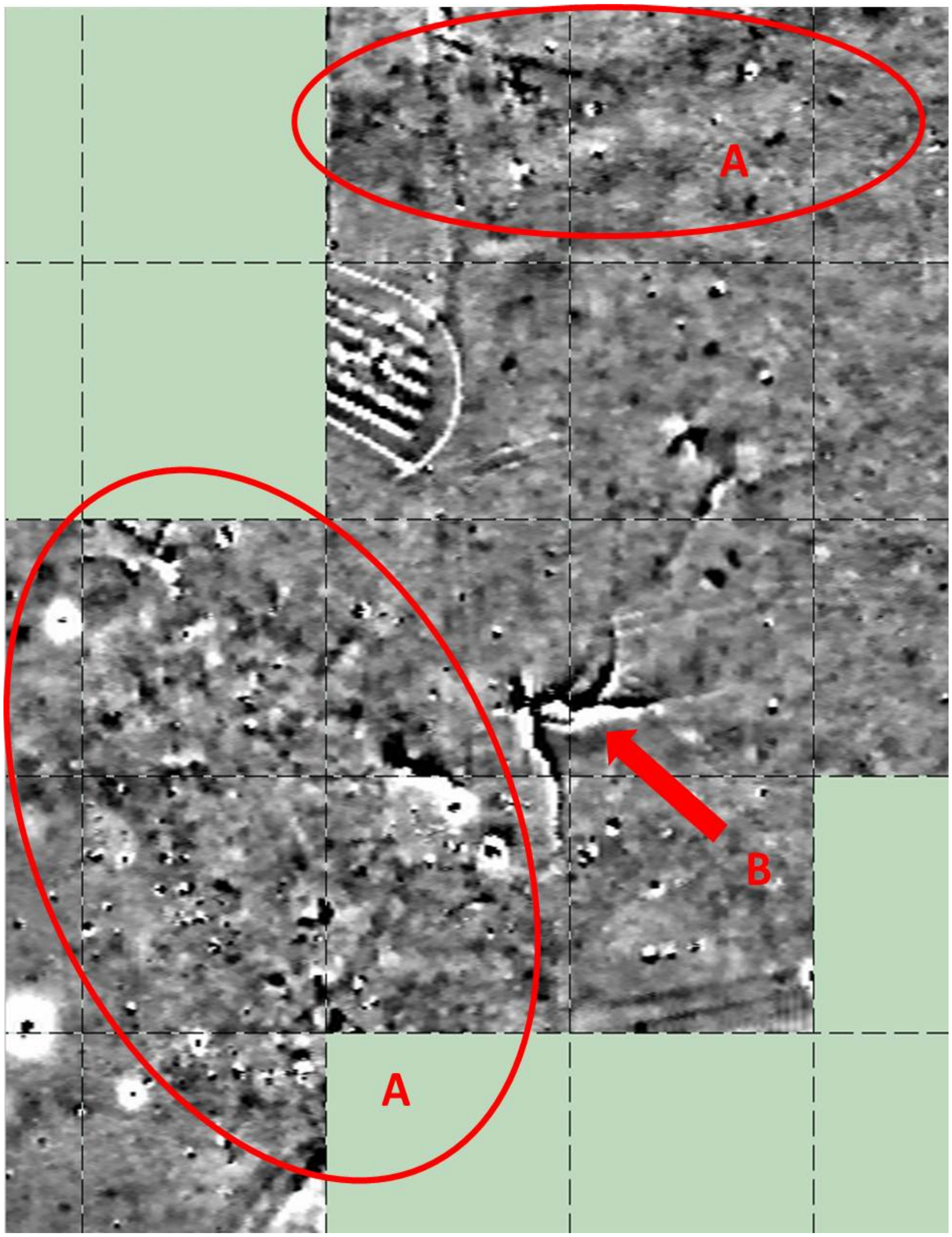

Figure 7.10:
Unidentified monopolar (a) and curvilinear dipolar (b) anomalies, from portions of grid blocks 17, 18, 19, 27, 28, 29, 38, 39, 40, 41, 42, 48, 49, 50, 51, 57, & 58 (see Figure 6.1 & 7.1) from NW corner of the survey area

Shovel Test Survey

A targeted shovel test pit survey was conducted over several of the more prominent anomalies, including the potential Mississippian structures and the "Zig-Zag" anomaly. In total, 91 shovel test pits were excavated, with 40 excavated at 15 meter intervals across the "Zig-Zag" anomaly in the north field and the remaining 51 excavated at mostly five meter intervals across the potential Mississippian anomalies (see Figure 7.11). Six of these were excavated at 15-meter intervals as part of the initial survey of the area; it was deemed unnecessary to drop to five-meter intervals because they were located off of the main landform. The shovel test pits that were concentrated around the "Zig-Zag" anomaly in the north field were all negative for cultural material. Several appeared to have a very deep A horizon, but were later determined to have shallow A horizons that had leeched into the B horizon below, blurring the soil stratigraphy (Monaghan, personal communication). Several of the shovel test pits were within a few meters or intersected the area of the anomaly, and these appeared no different than the surrounding shovel test pits.

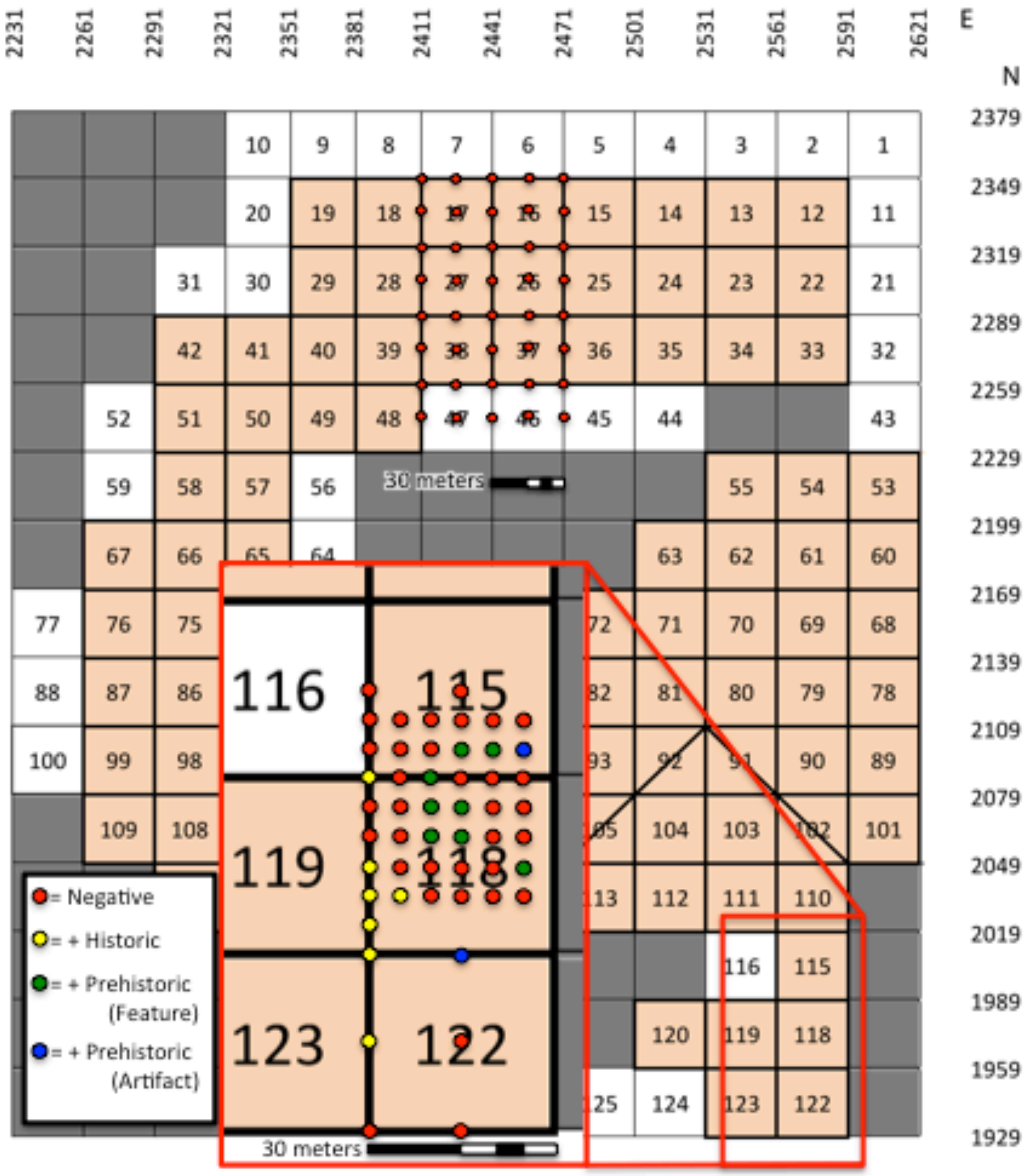

Figure 7.11: 2011 Shovel Test Survey Results

The shovel test pit survey of the potentially Mississippian anomalies in Grid Blocks 115 and 118 had much more in the way of both material culture and potential features. Seven STP's produced historic cultural material, including brick fragments, glass, nails, and coal slag. Brick fragments and coal slag were not collected. This material is assumed to be of either modern origin (several of these also contained modern tin foil wrapping) or of historic origin related to the WPA era excavations and work camp that were situated on the landform. The magnetometer survey appears to bear this out as well, showing a concentration of dipolar anomalies assumed to be a historic metal scattering at the base of the slope leading south off of the landform where the WPA and IU field school structures were located (see Figure 7.4 (c)), as if historic refuse washed or was deposited just off the landform. Two shovel test pits (N1959 E2576 & N1994 E2586) produced pre-contact artifacts, both of which were lithic flakes, one of which appears to have been heat altered in some fashion. Neither is what could be called a "textbook examples" of a flake and both were collected in part because of the known pre-contact presence on the landform.

The shovel tests that are of most interest to the research goals of this project are eight that show an irregular soil stratigraphy consisting of a darker lens (typically containing a majority of 10YR 4/4 or 10YR 4/3) of mostly silty loams below the B_E Horizon, all corresponding closely with magnetic anomalies noted in the geophysical survey in grid blocks 115 and 118 (see Figure 7.12). The potential features in six of these STP's vary between an initial depth of 33 – 47 cm below ground surface and an ending depth of 45 – 62 cm below ground surface. They ranged between 9 and 25 cm in depth.

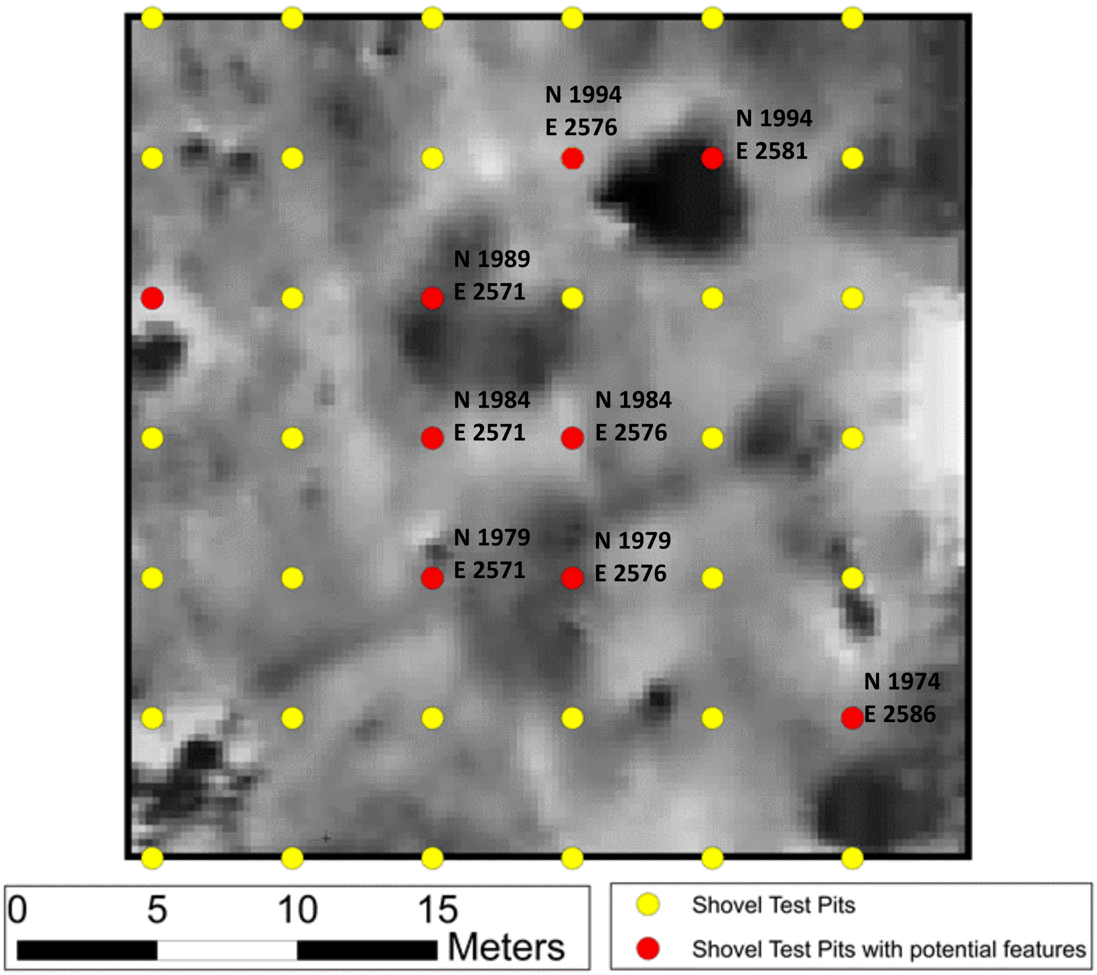

Figure 7.12: Magnetic Anomalies in Grid Blocks 115 & 118 at 25 x 12.5 cm spatial resolution with Shovel Test Pits containing potential features.

One of the STP's in this group contained a layer of silty loam with a Munsell color of 10YR 5/4 with 10YR 5/6 mottling and 5% charcoal flecking. The final potentially significant STP contained 5 separate stratigraphic layers that deviated from the 'normal' surrounding stratigraphy beginning at 12 cm below ground surface. This STP was excavated to a depth of 80 cm below ground surface before being terminated due to difficulty of excavation, not because of reaching a sterile soil horizon. Details of all of the Shovel Test Pits from 2011 can be found in Appendix 7.1 and specific details of positive

Shovel Test Pits from 2011 determined to be of potentially pre-contact significance (either from material culture or soil stratigraphy) can be found in Appendix 7.2.

<u>3rd Terrace Legacy Collection Analysis</u>

The focus of the analysis of the 1939 3rd Terrace legacy collection was on the largest component, the ceramic assemblage. As detailed previously, over 14,000 ceramic sherds, 3500 lithics, projectile points, ground stone tools, pipes, ceramic earrings, burnt daub, and charcoal, as well as several human burials, were recovered during the excavations. Although no quantitative analysis of the collection has been compiled, there are a number of patterns typical to Angel Mounds that have been noted. The majority of the collection is fragmented Mississippi Plain Ware body sherds containing shell and grog tempering. The most common decorative modifications are textile impressed sherds with a variety of patterns ranging from large fibers with a wide warp and weft to very fine fibers with a relatively tight warp and weft. Several sherds were also noted with a fine textured fiber with a diagonally oriented warp. At a much smaller frequency, although not uncommon, are examples of Bell Plain shell tempered ceramics, several of which are obviously plate fragments as defined by Hilgeman (Hilgeman 2000). Several examples of other decorative forms have been noted in much smaller quantity, usually represented at the moment by only a single sherd. These include a dowel impressed Vanderburgh Stamped rim sherd, a Matthews Incised scalloped rim sherd, several sherds with curvilinear incising, a Mound Place Incised (var. Chickasawba) rim sherd with rectilinear incising along the rim edge, several articulating Carson Red-on-Buff plate fragments, an example of red-slipped Old Town Red, as well as several instances of red and black painting, although there are no examples yet of any Angel Negative Painted, which is specifically associated with Angel Mounds. Several open and closed handle forms have also been noted, including narrow strap/loop and wide strap handles, indicative of earlier and later phases of the Angel Mounds occupation, respectively. Designations on pottery types, varieties, and temporal designations based on handle morphology were made using the definitions in Hilgeman's *Pottery and Chronology at Angel* (Hilgeman 2000).

Several other miscellaneous incised sherds were noted, as well as additional black slipped sherds, several sherds that may be effigy fragments, several decorative nodes, several other irregularly shaped ceramics, as well as several open handles (including trianguloid and oval lugs), several loop handles, and a narrow intermediate handle. Additionally, several ceramics were identified that can potentially be called 'cane impressed', but may also be daub from a wattle and daub structure, which would use cane as the lathe to hold together the mud walls (Dru McGill, personal communication). There is at least one large piece of the 'cane impressed,' however, which appears to have enough curvature to be part of a large ceramic vessel. These sherds appear to have been impressed with an instrument of much larger diameter than other textile impressed pieces, although the use of cane is only hypothesized at this point.

The largest difference noticeable between the 3rd Terrace and Angel Mounds as a whole is the absence of sherds that have been painted and the complete absence of any negative painted varieties, specifically the type named for the site – Angel Negative

Painted. Angel Negative Painted is found in higher proportions at Angel Mounds than any other Mississippian site in the region (Hilgeman 2000), but is entirely absent among the 13,591 sherds from the 3rd Terrace. According to Hilgeman's counts, roughly 2% of the Angel Mounds ceramics are decorated in some fashion, and of this 2%, 24.5% are Angel Negative Painted. When this estimate is applied to the 13,591 sherds from the 3rd Terrace, a hypothetical 66.59 sherds should be of the Angel Negative Painted type. It seems improbable that sherds of Matthews Incised, Vanderburgh Stamped, and Mound Place Incised would all be found within this collection and Negative Painted types would not, since these three types represent only 1.32% of the 2% of decorated sherds in the Angel Mounds' collection. There is obviously some reason for the lack of painted types and there may be several possible explanations.

As has been stated previously by Black, the 3rd Terrace appears to have soils that are more acidic and, therefore, more taphonomically destructive to ceramics in the ground. Black points to the "cells" left within the ceramic paste where shell tempering has almost completely or completely been leeched out as evidence. A similar absence of shell within the ceramics has been observed during the current research. In its place are layered voids that are reminiscent of where shell would have once been. In discussions with Indiana University doctoral student Dru McGill, whose dissertation centers around ceramic analysis of the Angel Mounds collection, he confirmed that while there are many indications of shell tempering leeching from ceramics on the main site, most of the shell tempered sherds he has evaluated still contain the majority of their temper (Dru McGill, personal communication).

It could be possible that this same taphonomic process has in some way acted upon hypothetical painted decorative elements of the ceramics from the 3rd Terrace. Black recorded only 12 instances of painting evident on ceramics of the 3rd Terrace out of the roughly 14,000 sherds that were excavated from the landform, a miniscule 0.086%. In the current reanalysis of the collection, 17 painted or potentially painted sherds were noted out of a total of 13,591 sherds. Twelve of these were red and five were black. These numbers include painted sherds only and not red or black slipped pottery, of which there were several examples as well, including a number examined by Hilgeman. Of these 17 sherds, several are questionable as to the extent of their painting. Painting that was evident on sherds from the 3rd Terrace was typically only present in trace amounts, and some sherds received their designation as painted because of articulations with other potentially painted pieces. Once articulations were noted, potential paint remnants that may have otherwise been missed were noticed as well. This includes three sherds that have been designated during the current research as Carson Red on Buff based on remnants of what appears to be red paint on three relatively fine, shell tempered, buffed plate fragments. Potentially, these sherds may represent a different painted variety that has been degraded past recognition. As Hilgeman hypothesizes -- “Some or all of the [Carson Red on Buff] sherds may represent Angel Negative Painted, *variety Grimm* sherds from which the negative painted portion of the design has faded completely” (Hilgeman 2000:47-48).

Two painted sherds were also found by the WPA crew at a later date “while digging a hole for a building foundation” according to the artifact bag and had no associated provenience information beyond the subdivision. Even these 17 painted sherds out of 13,591 amount to only 0.125% of the total, indicating either that the 3rd Terrace is indeed taphonomically more destructive to ceramics, especially painted types, or that this portion of the site contains disproportionately less painted ceramics than the main portion of the site. This could be for a number of reasons related to Mississippian agency, spatial divisions of labor, wealth and inequality, or any number of other potential avenues of inquiry. Ultimately, the determination of the cause of the discrepancy in the spatial distribution of and proportional counts of incised and painted ceramic varieties will rest upon further analysis of soil chemistry on the 3rd Terrace. Until questions of taphonomic variability can be confirmed or ruled out, any comparison of these varieties of ceramic materials will rest on shaky assumptions at best.

Ceramic Statistical Analysis

Beyond the initial statistical tests described in the preceding chapter using Hilgeman's measurements (Hilgeman 2000), the random sample of 30 measurable rim sherds (of a combined sample of all vessel types) obtained from the 3rd Terrace were subjected to the same statistical tests. A factor that needs to be considered is the potential difference in mean vessel orifice diameter that may be a result of differences in vessel type. Of the four vessel forms that were considered by Blitz, only three were shown to have a statistical correlation between vessel orifice diameter and vessel size – jars, bowls, and plates (again, bottles did not show this correlation and were excluded) (Blitz 1993). These four types are the same that Hilgeman uses in her analysis (Hilgeman

2000) and, therefore, only jars, bowls, and plates are considered here, both from Hilgeman and the main Angel Mounds ceramic collection and from the 3rd Terrace.

Individual ANOVAs were run for each vessel type comparing mean vessel orifice diameter across the same four areas of the site. No individual vessel type of the three considered showed any statistical difference in mean vessel orifice diameter. The results of the individual ANOVAs are as follows – Plates = (F=1.037, α=0.05, df=3, p=0.375); Jars = (F=0.614, α=0.05, df=3, p=0.606); and Bowls = (F=1.841, α=0.05, df=3, p=0.139). Because the datasets for these individual analyses were divided from the overall assemblage, in some cases sample sizes drop below 30, the level that represents the minimum for a solid statistical sample. These specific cases are as follows – Plates = 3rd Terrace (n=5); Jars = 3rd Terrace (n=19), Mound F (n=4); & Bowls = 3rd Terrace (n=5), Mound F (n=8). Full statistical results of the individual ANOVAs, including post hoc Scheffe tests, can be found in Appendix 7.3.

When a Chi-Square test is conducted using the frequencies of various vessel types across different areas, a statistically significant result is shown in all areas of the site. For each area analyzed there is a statistically significant result of for differences in frequencies of vessel type (Angel Mounds as a whole [X^2 (df=2, n=1942) = 309.746, p < 0.001]; Mound F [X^2 (df=2, n=81) = 98.296, p < 0.001]; W-10-D in the East Village [X^2 (df=2, n=406) = 101.768, p < 0.001]; and the 3rd Terrace [X^2 (df=4, n=34) = 28.941, p < 0.001]). When a frequency table is created for each area, it becomes apparent that while Angel Mounds as a whole (983/1942 = 50.61%), Subdivision W-10-D in the East Village (223/406 = 54.92%), and Mound F (69/81 = 85.19%) all show a significantly higher percentage of plates as a part of their assemblage, the 3rd Terrace shows a significantly higher percentage of jars (19/34 = 55.88%). See Appendix 7.4 for full statistical results of the Chi-Square test and frequency distribution table.

One final word of caution is warranted when interpreting these results. At this time, there is not a published or completed analysis of plainware vessels at Angel Mounds. Although work on this avenue of research is ongoing by doctoral student Dru McGill, it has not been completed. All measurements that were taken by Hilgeman and used in this analysis are of either decorated vessels or those that contained handles, which were used in the creation of her ceramic chronology (Hilgeman 2000). For the 3rd Terrace, while many of Hilgeman's decorated sherds were used, a large number of undecorated examples were used as well. This may account for the differences in vessel type frequencies, as plates are more likely to be of the decorated Angel Negative Painted variety and jars are more likely to be plainware utilitarian vessels. As additional resources and datasets utilizing the plainware portion of the Angel Mounds ceramic assemblage become available, more refined statistical comparisons may be able to be conducted.

^{14}C Dating of 3rd Terrace Occupation

In addition to the ceramic analysis, sources of potentially viable floral and faunal samples were identified for ^{14}C radiometric dating. Dr. Leslie Bush of Macrobotanical Analysis identified the specimen that was sent for analysis as a stem from *Arundinaria gigantean*, commonly referred to as River Cane. This specimen was chosen over a sample of hickory and several specimens of *Odocoileus virginianus* (White Tailed Deer) and one Fox Squirrel (*Sciurus niger*) femur because the River Cane is an annual plant providing a more precise date. Further detailed analysis upon the faunal remains was not conducted after the sample was ruled out as an ideal carbon sample. The sample was sent to Beta Analytic Radiocarbon Dating Laboratory and was determined to have a conventional radiocarbon age of 690±30 B.P. with an intercept of the radiocarbon age with the calibration curve at Cal A.D. 1280 (Cal B.P. 660), a 1 Sigma calibrated result (68% probability) of Cal A.D. 1280 to 1290 (Cal B.P. 670 to 660), and a 2 Sigma calibrated result (95% probability) of Cal A.D. 1270 to 1300 (Cal B.P. 680 to 640) and Cal A.D. 1360 to 1380 (Cal B.P. 590 to 570) (see Figure 7.13). On its own this date contributes little to the interpretation of the material from the 3rd Terrace, and also cannot be attributed to the potential Mississippian magnetic anomalies. However, when incorporated into the larger chronological development of Angel Mounds, this date may place activity on the 3rd Terrace in relation to important periods in the history of Angel Mounds. Further detail of this possible association will be discussed in the concluding chapter.

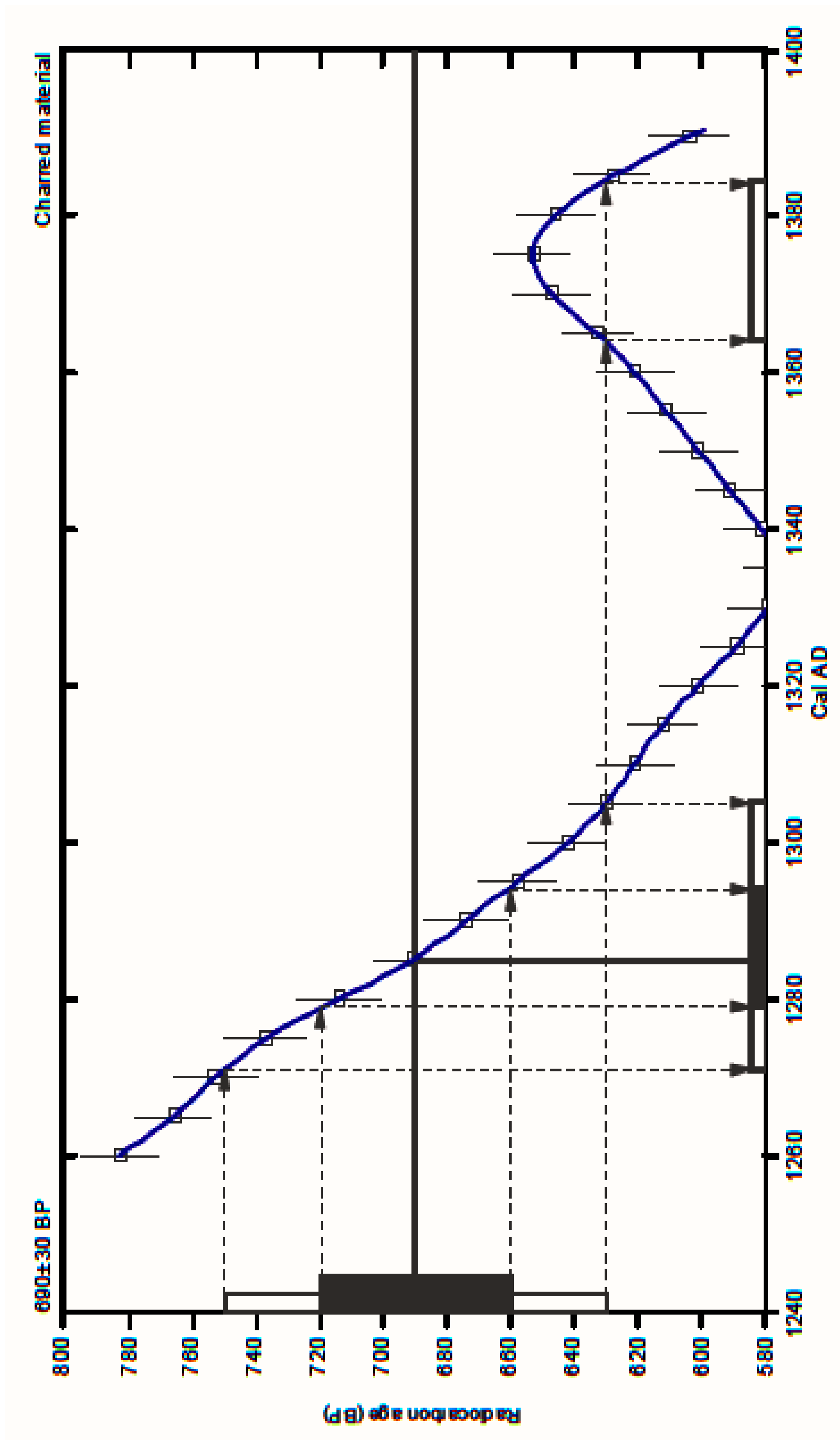

Figure 7.13: ^{14}C date from Feature 3 / X-7-D on the 3rd Terrace Processed by Beta Analytic, Inc. (Lab # - 313068)

Chapter Eight - Discussion and Conclusions

Magnetometry

The results of the magnetometer survey revealed that there is an absence of magnetic anomalies on sections of the 3rd Terrace that were surveyed that would match in scale or type those anomalies present within the palisade of the Angel Mounds site proper. The dominating characteristic of the magnetic survey of the Angel Mounds site proper is the multiple groupings of anomalies consistent with burnt houses that were revealed in various locations across the site (Peterson 2010), affirming the results of the East Village excavations (Black 1967), which showed a densely packed area of structures interpreted as dwellings. In contrast, there is a distinct scarcity of any anomalies suggestive of a dense occupation of the 3rd Terrace during the Mississippian period. The few magnetic anomalies that are potentially related to a Mississippian presence on the landform are closely grouped and potentially overlapping, although the scarcity of pre-contact material culture associated with these magnetic anomalies does not lend weight to their designation as a dwelling or structure similar to those on the main site. Two lithic flakes were found in the vicinity, one that was 5 meters east of an STP positive for a feature, and one 20 meters south of an STP positive for a feature. However, the presence of the legacy 3rd Terrace collection cannot be ignored and the variety and number of artifacts that were excavated only dozens of meters away suggests that the area was utilized in some fashion, perhaps extensively, during the Mississippian period. The presence of stratigraphically distinctive layers within shovel tests that overlap areas of these magnetic anomalies also supports their designation as potential features associated with the site. In addition, subsequent shovel testing that was conducted during the 2012 field season recovered a number of plainware sherds to the west of the anomalies, closer to the area of the 1939 excavations (Jeremy Wilson, personal communication). Although this area was utilized during WPA era archaeology for processing of artifacts from the main site, the presence of these additional ceramics lends weight to the possibility that additional cultural features have yet to be investigated.

The presence of these potentially significant anomalies upon the terrace edge makes other areas along the edge of the 3rd Terrace more viable for potentially locating additional magnetic anomalies that may correspond with Mississippian structures. During the 2011 field season, one of these areas west of the Angel Mounds Museum had been given over to prairie grass as part of a government program encouraging the growth of prairies. This unfortunately made surveying this area with a magnetometer difficult and an unproductive use of resources. During the 2012 field season, this area was surveyed, although there were no magnetic anomalies present that were similar to those either on the main Angel Mounds site or near the 3rd Terrace excavations. This area was previously disturbed by excavation and installation of a septic system leech field for the Angel Mounds Museum. While no anomalies exist that are analogous to the anomalies in Blocks 115 and 118, there are other more amorphous and ambiguous magnetic anomalies that may warrant investigation in the future, especially prior to ground disturbance (see Figure 8.1). The remainder of the accessible terrace edge is now occupied by the Angel Mounds Museum, including a buffer zone of fill dirt that

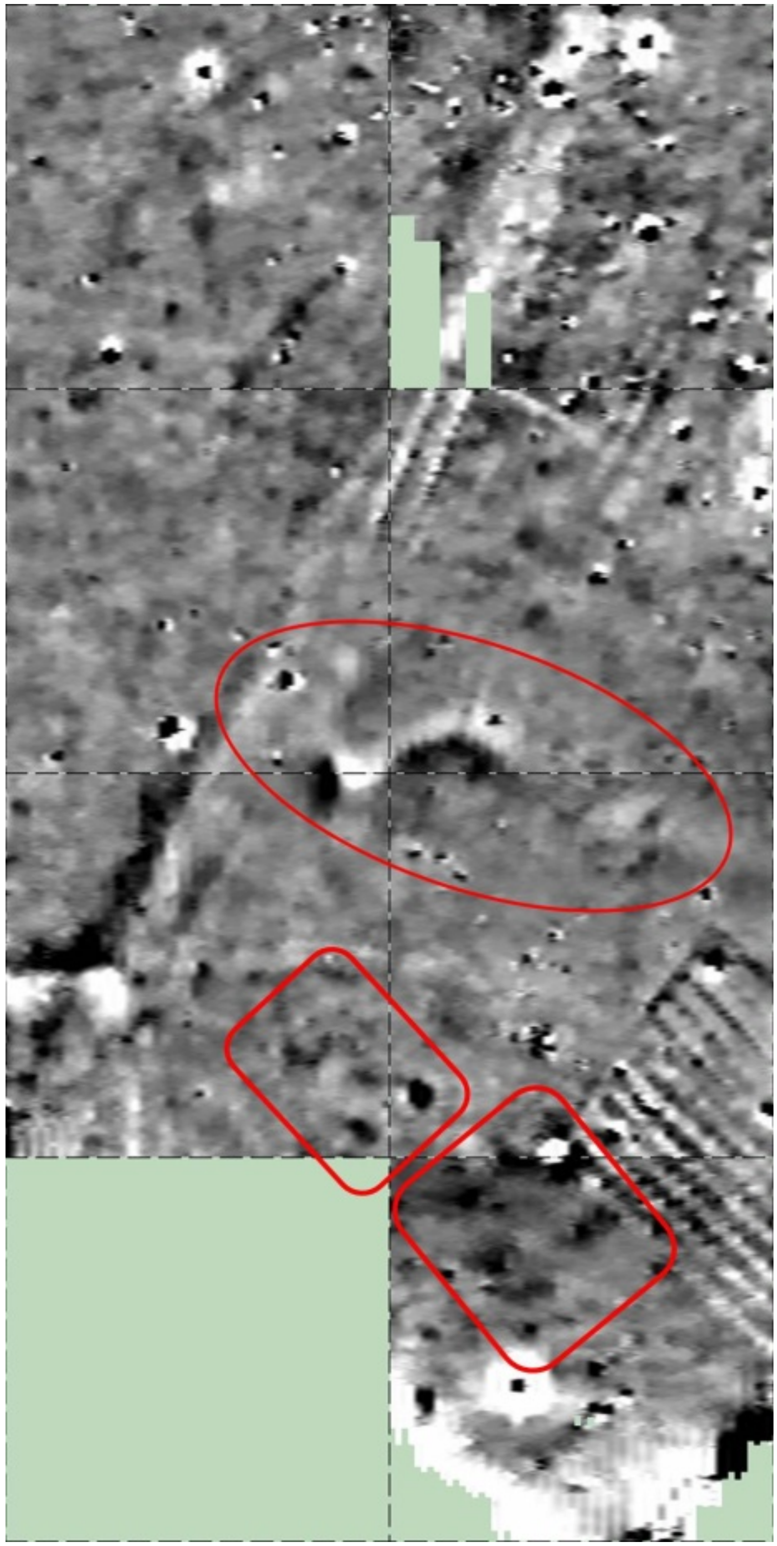

Figure 8.1:
Amorphous potential anomalies from the western terrace edge in grid blocks 86, 87, 98, 99, 108, 109, & 126 (see Fig. 6.1 & 7.1) in SW corner of the survey area

makes a magnetic survey futile. The same can be said of the areas north and west of the main Angel Mounds site, which are forested and unable to be magnetically surveyed. Additional areas surrounding the magnetic anomalies present near the 3rd Terrace excavations were also surveyed in 2012. These small areas had previously been given over to underbrush and were used as a dumping ground for construction materials, including various forms of magnetic metals. Although cleaned and cleared for the 2012 field season, the remnant bits of metal and the proximity of these locations to existing metal structures and utilities made the presence of Mississippian cultural features indeterminable in these areas (see Figure 8.2).

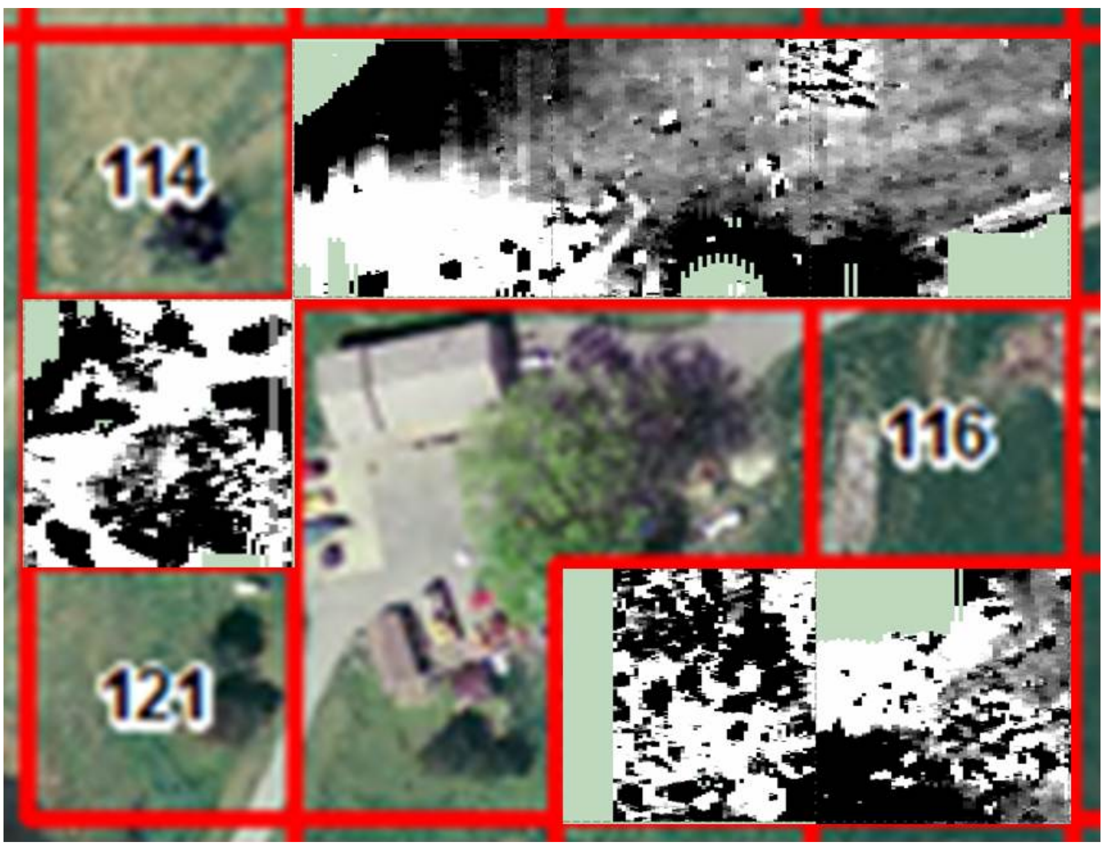

Figure 8.2: Metallic magnetic disturbance surrounding the Angel Mounds Historic Site utility garage and outbuildings

The areas and magnetic anomalies related to the WPA era excavations are also of significance to this project and the site in general. Multiple magnetic anomalies can be reliably associated with structures that were either present during the WPA era excavations or during the period of IU field school excavations led by Black from 1945 onward. These include barracks where IU field school students were housed, a barn that was part of the original WPA excavations, and several privies. Magnetic anomalies are well defined in the areas of the IU field school barracks (see Figure 7.3 (a)) and are consistent with these structures from historic aerials and from a DNR engineering survey (see Figure 7.4 (a & b)). The barn and privies are not well defined magnetically, being overshadowed by magnetic noise from structures and debris. However, when georectified with the DNR survey and sufficiently processed, potential magnetic anomalies are present, although not necessarily where building footprints are to be expected (see Figure 8.3). Being related to the programs brought about by the Works Progress Administration, and being of significant time depth, these structures could potentially qualify for similar protections that are afforded the pre-contact components of the site. Because some of the staff currently employed at Angel Mounds State Historic Site remember these structures, they are in a unique position to be used as part of the interpretation of the site and its history, not only related to the Mississippian peoples of Angel Mounds, but also to the beginnings of modern archaeology through the story of Glenn Black, the WPA and subsequent IU field schools.

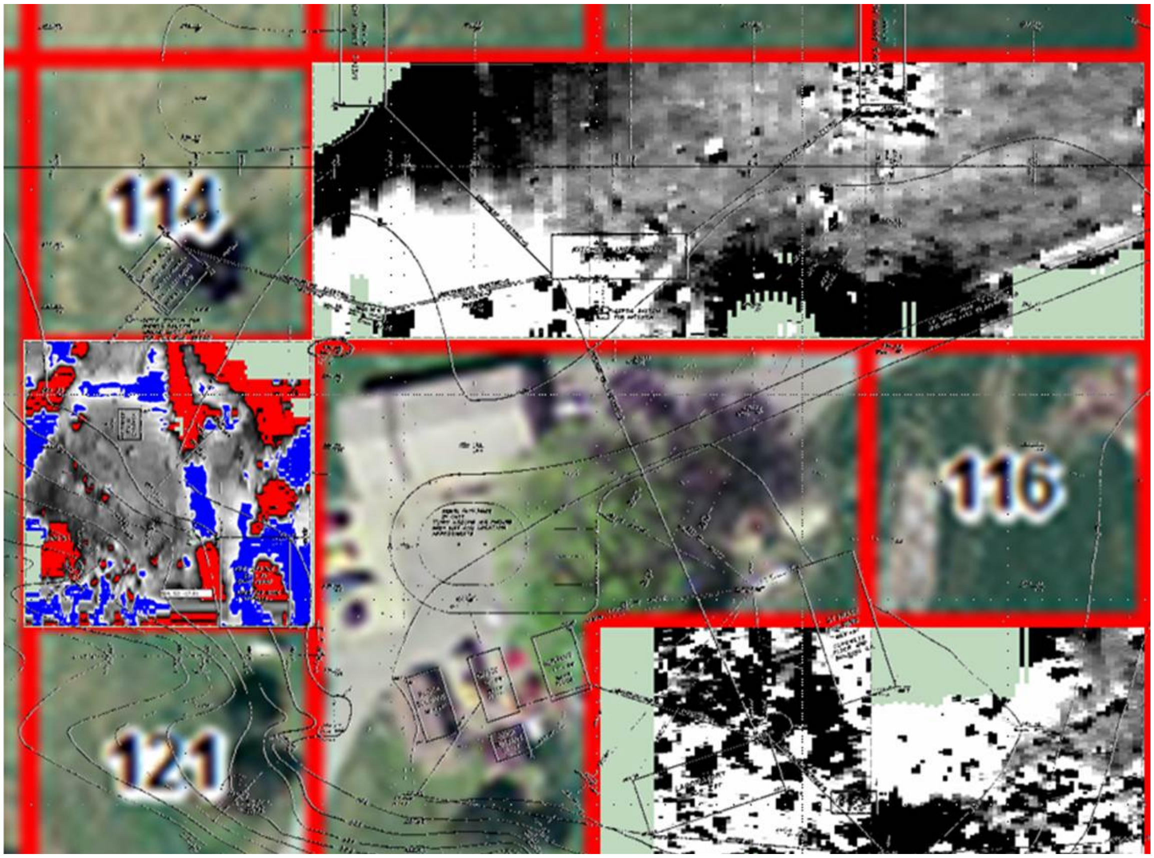

Figure 8.3: Potential anomalies west of utility garage georectified with DNR Engineering

Shovel Test Survey

The hope that an association between Mound G (12W54) and the Angel Mounds site could be established through the magnetometer survey and targeted STP survey was not borne out. Although there are notable magnetic anomalies in the northern field, including the "Zig-Zag" anomaly and other irregular linear and curvilinear anomalies (see Figure 7.5 & 7.9), the presence of anomalies that would be suggestive of Early or Middle Woodland structures or any artifacts relating to a general Woodland occupation of the landform were not present in areas that were surveyed. Additional shovel tests of areas closer to Mound G, including the forested areas now surrounding the mound, may be more fruitful in terms of producing material culture. Additionally, targeted soil probe testing on several of the linear magnetic anomalies may shed additional light on whether or not they have the potential to be significant to any of the temporal phases potentially associated with the area.

Within the vicinity of the 3rd Terrace excavations, the shovel test survey proved useful in further defining properties of the soil that were detected during the magnetic survey. Additional information was gleaned through ground truthing these anomalies, including depths and stratigraphy of potentially culturally related soils, as well as emphasizing the boundaries of the anomalies. Eight shovel tests show soil profiles that vary from the natural soil profile of the majority of the survey. My initial interpretations of the dark soil zone located variably between 33 and 62 cm below ground surface is that this is the feature which displays an increase in the magnetic gradient that presents itself as the positive anomalies from Block 115 and 118 in the magnetic survey. As mentioned previously, anthropogenic soils have a tendency to accumulate magnetically rich materials from the presence of fired and/or burnt materials, as well as from the biodegradation of increased amounts of organic material and waste by magnetotactic bacteria. If these soil zones are associated with a human occupation in the area, the latter likely occurred. The increased presence of charcoal within many of the tests at this level also shows that the former almost certainly occurred as well.

The shovel test located at N1989 E2571 shows the presence of at least five soil zones that do not seem to be created through natural soil formation and weathering processes. Within this test, charcoal is present from 12 – 40 cm below surface, while the next four layers beneath are all significantly mottled soils with varying combinations of 10YR 5/6, 10YR 4/4, 10YR 6/6, 10YR 4/3, and 10YR 5/3. The main component of the matrix of the three layers from 40 – 80 cm below surface are all either 10YR 4/4 or 10YR 4/3. The complexity of the stratigraphy of the soil within this test and its location within the boundaries of a positive magnetic anomaly also provides additional support for the hypothesis that these magnetic anomalies represent a cultural feature on the landscape.

Unfortunately, there is a paucity of material culture evidence from the shovel test survey in 2011 of this area to support the designation of these anomalies as cultural features. In terms of pre-contact artifacts, there are only two pieces of lithic debitage and their designation as such is based as much on their presence near the area of the 3rd Terrace excavations as any morphological characteristics that would classify them as an artifact. The lack of a significant material culture assemblage from the survey does bring into question the assignment of these anomalies to the same category of structure as similar ones from the site proper. However, it does not completely negate the geophysical data. The location of this area outside of the main site and the palisade wall, and especially outside of the bounds of the densely populated East Village, would likely mean that the density of artifacts at this site would be significantly sparser, even if it were a dwelling. At this time, however, there is no basis in designating these anomalies as dwellings. There is still much ambiguity on the main site as to the designation of structures to a specific use, even after excavation. At this time, based upon the similarity of the geophysical survey data and the supporting soil stratigraphy from the shovel test survey, these anomalies can be designated as cultural features. In spatial and spectral signature, they are very similar to many anomalies from the main

Angel Mounds site, but should not be assumed to be as such until further investigation has taken place. In the absence of a reliable ^{14}C date or culturally diagnostic artifacts from a good stratigraphic context associated with these anomalies, they cannot be given a temporal designation. It is safe to hypothesize that they are of Mississippian origin based upon their similarity to others on the main site and their proximity to the relatively artifact-dense 3rd Terrace excavations, but should not be assumed to be so until confirmed.

3rd Terrace Legacy Collection

The analysis of the 3rd Terrace collection has left more questions beyond what it has answered. As previously conjectured, the results of the statistical analyses on the 3rd Terrace ceramics are inconclusive. While there are significant statistical differences in overall vessel mean orifice diameter between the 3rd Terrace and Mound F, as well as significant differences in frequencies of vessel type between the 3rd Terrace and the rest of Angel Mounds, the context of the ceramic assemblages is disparate enough that the results should be cautiously interpreted. Because Hilgeman's analysis was based entirely upon decorated vessel forms and those with handles, and because an exhaustive analysis of plainware vessels from Angel Mounds is not yet complete, the comparison of the 3rd Terrace ceramic assemblage to the main Angel Mounds site is tenuous.

Further work with this ceramic collection needs to be undertaken to better understand the 3rd Terrace's relationship with the rest of the Angel Mounds site. Roughly 50% of the potential rims to be measured and analyzed from this collection can still be incorporated into these calculations at a later date. This additional data may expand upon the sample size enough that the individual vessel forms of plates, jars, and bowls may attain a sample size exceeding 30, providing a much more reliable statistical test. Additionally, when data for the morphological trends of plainware vessels from Angel Mounds becomes available, the same or similar statistical tests can be run to provide a more accurate representation of the potential differences in vessel morphology between this and other areas of the site.

One benefit of the reanalysis of the 3rd Terrace ceramic assemblage is the better understanding that has been gained of the collection and processing practices of the WPA workers that created this collection. The identification of additional ceramic varieties beyond what was identified by the original lab processers speaks to the need for an analysis of large collections that goes beyond what is written in the FS log or even in a compiled site report such as the Angel Mounds volumes by Black and Kellar. Additionally, after physically examining the entirety of the 3rd Terrace ceramics during initial processing, I can conjecture that a disproportionate amount of the shell tempering had been leeched out of the sherds when compared with those from the main site. The potential difference in soil conditions and taphonomic weathering of the site that may be the cause of this difference has potential implications on other aspects of the ceramic assemblage. Up to this point, limited painted varieties have been identified on the 3rd Terrace, and none of the Angel Negative Painted variety. Perhaps examples of these varieties more common from the main site have been degraded to the point where they are no longer recognizable, as Hilgeman conjectured may be the case for the examples of Carson Red-on-Buff (Hilgeman 2000). Until a detailed assessment of differences in soil condition can be conducted in relation to their effect upon the taphonomy of the ceramic component of the assemblage, this again remains conjecture. However, the presence of relatively rare incised decorated vessel forms that were identified during my initial analysis of the collection suggests that the absence of painted material may be anomalous when compared with the proportions of incised decorated forms to painted decorated forms catalogued by Hilgeman (see Table 4.1 for precise counts and percentages, compiled from Hilgeman) (Hilgeman 2000). Alternatively, different proportions of ceramic vessel varieties may denote an as yet unexplored social, economic, or political difference in the use of the land on the 3rd Terrace when compared with the rest of Angel Mounds.

There are several hypotheses that seem to be supported by the 3rd Terrace ceramic assemblage. One of these is that there is potentially a considerable temporal depth of cultural use of this area of the landform. The main supporting evidence for this is the presence of a variety of vessel handles morphologies present within various features that were identified archaeologically. The basis of this designation is the ceramic chronology developed by Hilgeman that seriated morphological change in closed form vessel handles throughout the time of the Mississippian occupation at Angel Mounds. While the absolute chronology of this seriation has recently been called into question as new radiocarbon dates and stratigraphic interpretations emerge, the distribution of these handle forms across a span of time seems to remain valid. This seriation begins in time with loop handles – those whose width are similar to their thickness – and changes through time to strap handles – those whose width is near 10 times the thickness of the handle with various intermediate forms in between (Hilgeman 2000). The 3rd Terrace has all of these forms present, suggesting either an extended use or multiple episodes of use of the landform (see Figure 8.4 for examples of the variety of closed handle morphologies from the 3rd Terrace).

In terms of establishing a chronology for the use life of the 3rd Terrace landform, there are several limiting factors. The new chronological model for Angel Mounds (Krus, et al. 2012) reveals that site use begins with mound construction at an early date of A.D. 1050-1080 (Monaghan and Peebles 2010; Krus, et al. 2012), while palisade and village construction did not occur until after A.D. 1300, essentially separating the site into 1) an early phase ceremonial center with a low resident population and 2) a later phase with a walled village and a greatly increased resident population (Krus, et al. 2012). This model differs from that of Hilgeman, who proposed a two phase chronology based on her ceramic seriation and associated radiocarbon dates with Angel II from A.D. 1200-1325 and Angel III from A.D. 1325-1450 (Hilgeman 2000). It is therefore difficult to fit the ceramics of the 3rd Terrace into the newly proposed chronological model, other than to say that both 'early' and 'late' ceramics are represented.

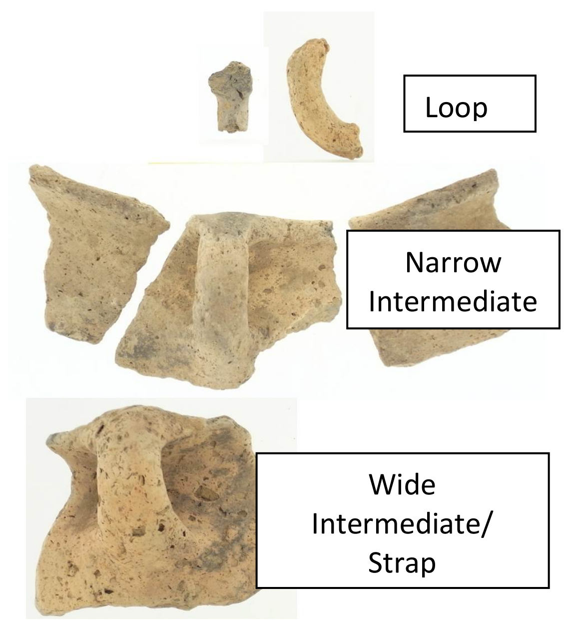

Figure 8.4: Variety of closed handle morphologies from the 3rd Terrace representing a potentially lengthy temporal depth.

As previously mentioned, one radiocarbon date was obtained from the 3rd Terrace material on a sample of river cane that comes from one of the features excavated by Black in 1939. The feature that the river cane sample was excavated from was Feature 3 from subdivision X-7-D (see Figure 8.5), whose excavation was described by Black in some detail --

> "Very near the center of the block, resting working floor at a level of 1.48 feet below grade, two parallel strips of charred wood were found. There were oriented northwest-southeast and did not have the appearance of accidental occurrence. They were left in place, and it was not long until, about two feet to the southeast, and on the same level, a badly cracked pottery vessel was discovered. Then, at about an equal distance northwest of the charcoal, but at a slightly lower level, the rim of a larger vessel was discovered. The latter, when cleared of matrix soil, was found to be a cracked bowl, with parts of the body missing, inside which was a smaller bowl. Adjacent to and south of this bowl was a small effigy bowl. Upon each side of the latter winglike appendages had been modeled in relief and incised to represent a feather pattern. At one side of the rim a luglike horizontal projection represented the tail and at the opposite side a stub was the remnant of the neck and head of the bird. The tail and head appendages on wide-mouth bowls are typical of a class of Middle Mississippi pottery, but wings, represented by modeling and incising, are a less common feature. These items, perhaps even including the charcoal strips, were not accidental within the inhabited area. They had been quite deliberately placed. There was not a trace of bone to indicate the presence of an inhumation. Perhaps it is hardly correct, therefore, to consider the vessels as burial inclusions, but that would be the only rational explanation for their presence."
>
> (Black 1967:94-96)

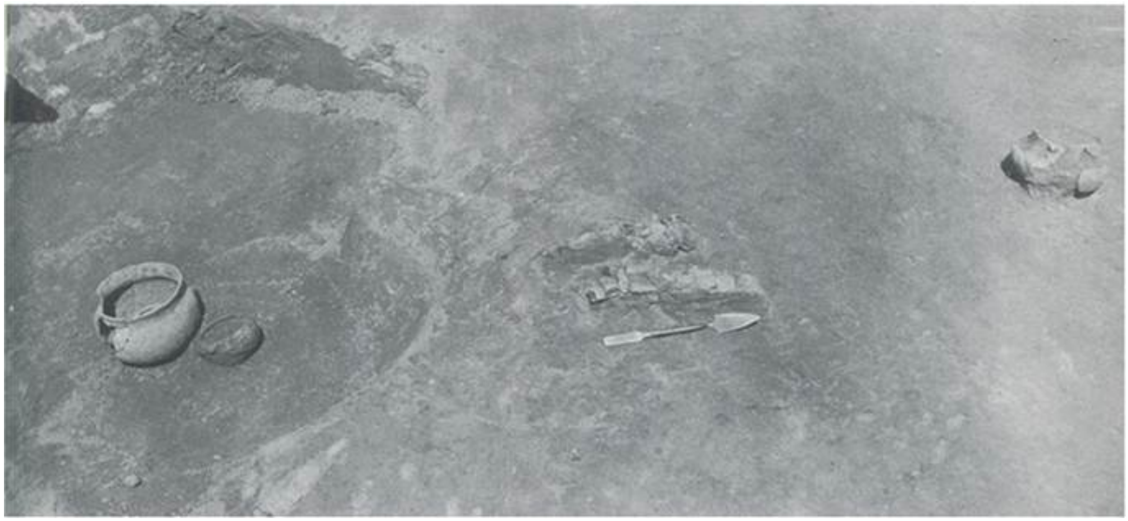

Figure 8.5: Feature 3 / X-7-D from the 3rd Terrace (Black 1967:95)

Based upon the excavation records by Black and the Angel Mounds volume (Black 1967), a very limited number of artifacts were associated with this feature. These include a sample of burnt hickory wood recorded as having the exact same piece plot provenience as the sample of river cane that was dated, four whole ceramic vessels, and associated soil samples taken from within each of the ceramic vessels. The ceramic vessels are described in the previous quote from Black. The ^{14}C date has an intercept of radiocarbon age with the calibration curve at Cal A.D. 1280 (Cal B.P. 660) with a 1 Sigma calibrated result (68% probability) from Cal A.D. 1280-1290 (Cal B.P. 670-660) and a 2 Sigma calibrated range (95% probability) from Cal A.D. 1270-1300 (Cal B.P. 680-640) and Cal A.D. 1360-1380 (Cal B.P. 590-570).

This date places the feature within the middle of the accepted ranges for Angel Mounds of A.D. 1050 to A.D. 1450 (Monaghan and Peebles 2010; Baumann, et al. 2011). While there is some overlap in this date with the later end of the occupation at Angel Mounds, the date is more likely to be prior to AD 1300 and to come from relatively early on in the occupation of the East Village and may actually precede the East Village and the initial construction of the palisade wall all together. Because this date falls on the cusp of the initial construction of the palisade wall, it is difficult to interpret this feature's relationship with the rest of Angel Mounds. While it is tempting to assign this date to prior to the construction of the palisade, it does not appear distinct from the earliest dates on the palisade, although it has not been incorporated into any chronological model for the site. Likewise, this date also seems to precede most dates from the East Village, although again it has not been statistically compared. Regardless, the likely date of just prior to AD 1300 falls during an important transitional phase in the history of Angel Mounds, represented through the aggregation of a dense population and the construction of defensive fortifications. This has been documented through the new interpretations of the chronological development of Angel Mounds (see Figure 8.6) (Krus, et al. 2012).

The presence of multiple varieties of ceramic decorations and handle morphologies that occur in concentrations across the chronological spectrum of Angel Mounds suggest that this area of the site cannot be limited in time depth by one ^{14}C date. Examples of this distribution include narrow strap/loop handles and Mound Place Incised (as well as other incised) pottery as indicative of Hilgeman's earlier Angel II phase occupation, while wide strap handles and Vanderburgh Stamped (dowel impressed) pottery are indicative of a later Angel III phase occupation (Hilgeman 2000).

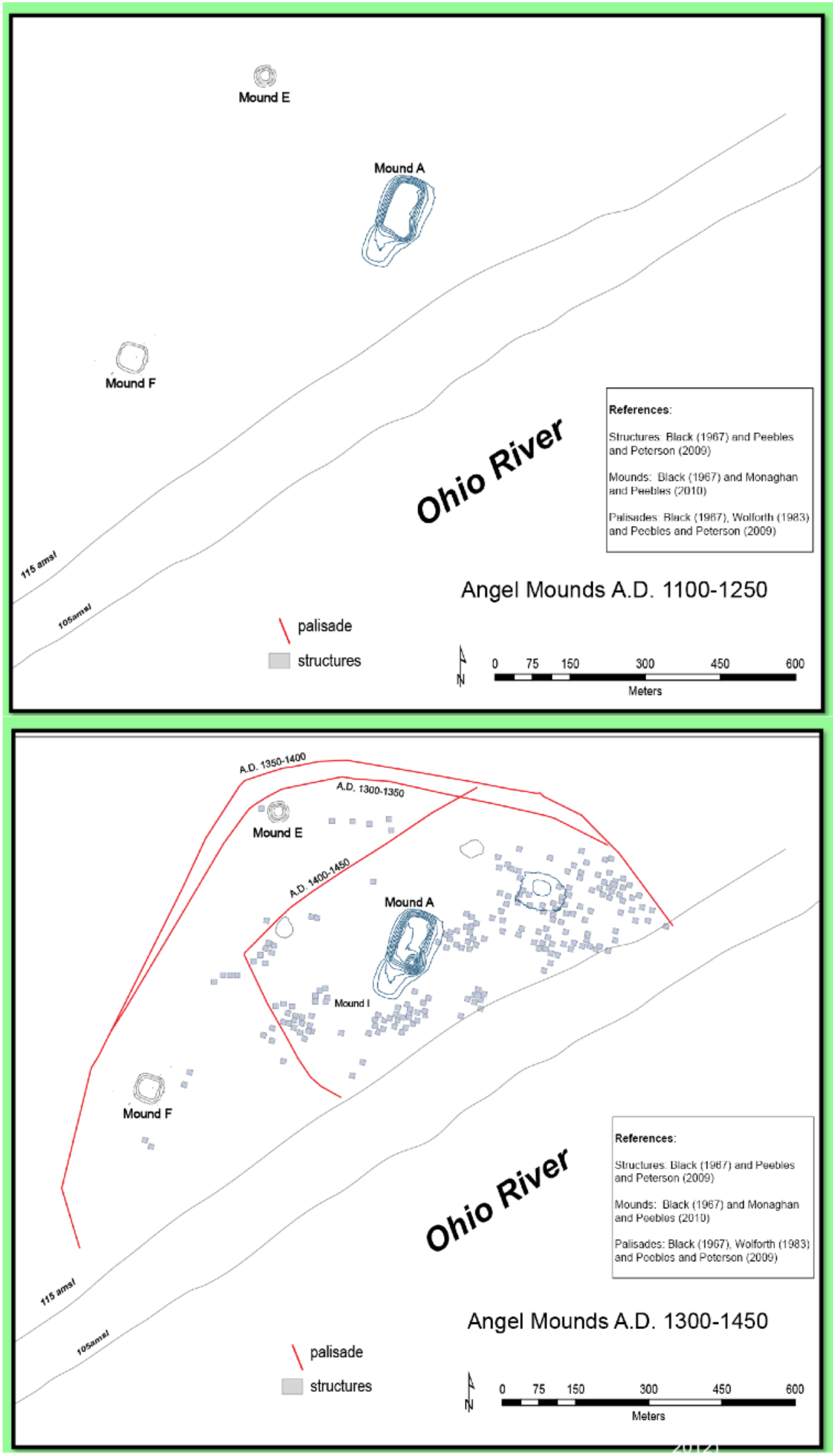

Figure 8.6: New Angel Mounds Chronology (Krus, et al. 2012)

Conclusions

Based upon the three-part approach to research on the 3rd Terrace, comprised of geophysical survey, shovel test survey, and reanalysis of the 3rd Terrace legacy collection, several preliminary conclusions can be drawn. As has been previously discussed (Black and Johnston 1962; Ball 1999; Peterson 2010), Angel Mounds is well suited to investigation by geophysical survey. With this in mind, it can be stated that there is little significant Mississippian modification of the landscape on the 3rd Terrace comparable to the kind seen within the known extent of the main Angel Mounds site. There are, however, potentially culturally formed magnetic anomalies present upon the 3rd Terrace, including some of potentially Mississippian origin. The presence of magnetic anomalies near the location of Black's original 3rd Terrace excavations, which are corroborated both by similarity in shape and magnetic signature to 'household' anomalies on the main site and the presence of anomalous soil profiles in spatially corresponding shovel tests, have significant potential to be of Mississippian origin. This is supported not only by the proximity of large concentrations of Mississippian cultural material from the 1939 excavations, but also by the significant temporal depth of deposits suggested by the varied ceramic handle morphologies noted within the ceramic assemblage from the 3rd Terrace. This, along with the contemporaneous ^{14}C date from a feature context in the original excavations, should prompt future research in the area to consider the 3rd Terrace assemblage as a significant part of the main Angel Mounds site, rather than a separate manifestation of Mississippian people in the area.

There is also potential for additional presence of cultural features related to the Mississippian occupation of the landform further along the 3^{rd} Terrace edge. While magnetic survey in the far southwest corner of the survey area (along the terrace edge) did not result in magnetic anomalies consistent with the anomalies in grid blocks 115 and 118 or the main Angel Mounds site, there are magnetic anomalies present that may warrant further investigation prior to any ground disturbing activities. In addition, the reforestation of the majority of the 3^{rd} Terrace to the west of the Angel Mounds museum and interpretive center, and especially the terrace edge, makes a determination of a cultural presence in these areas difficult via geophysical survey. It is recommended that a shovel test survey be performed along the extent of the terrace edge in the future to determine the presence of additional occupation data.

The remainder of the 3^{rd} Terrace that is now occupied by the interpretive center parking lot and open fields given over to periodic agriculture does not appear to have a significant Mississippian or Woodland period alterations based upon the geophysical survey and limited shovel testing in the area. This does not preclude the potential for the location of cultural deposits through a more thorough shovel test survey or a complimentary geophysical survey, such as electrical resistivity or ground penetrating radar. The presence of anomalies related to the Euro-American occupation of the landform, including those corresponding with structures from the WPA and IU archaeological periods, as well as anomalies potentially related to earlier Euro-American agriculture on the remainder of the landform provide us with a roadmap for the investigation of later periods of the site's history and additional support for the lack of prehistoric features in the area. Regardless, additional subsurface testing of the area is recommended prior to any ground disturbance on this terrace.

In addition to the remaining archaeological potential for intact deposits on the 3rd Terrace, there also remains significant analytical potential within the previously excavated 3rd Terrace material culture assemblage. While a preliminary analysis of the ceramic component of the assemblage was conducted here, additional areas of analysis remain, including the lithic and faunal components of the collection. Based upon vessel orifice diameter, there was no statistically significant distinction between vessel size on the 3rd Terrace to other, previously mentioned, portions of the main Angel Mounds site. However, this analysis was not exhaustive and the remainder of the ceramic assemblage beyond the representative sample analyzed here could potentially change the initial interpretations that I present here. In particular, a division of vessels based upon vessel form (jar, bowl, plate, bottle, etc.) is recommended once the inclusion of additional samples increases the count of any given category to a statistically significant and comparable level to similar data sets from other areas of the site.

Additional soil analysis of the 3rd Terrace is recommended prior to any additional comparisons between legacy collections of the 3rd Terrace and the main Angel Mounds site. While the differential taphonomic effects on cultural material, including shell tempered ceramics in particular, has been noted (Black 1967; Kellar 1967), to my knowledge no systematic analysis of differences in soil chemistry across the site has been conducted. While differences in proportions of decorated ceramic types from the 3rd Terrace to the main site could be the result of explicit choices in the differential utilization of space, they could just as likely be the result of variability in taphonomy on the site. Interpretations regarding these differences cannot be made until a more definitive analysis has been conducted; however, a relatively larger proportion of incised ceramics to painted ceramics on the 3rd Terrace may suggest some difference here, whatever the cause.

Investigation of the 3rd Terrace is far from being complete. As one of the initial goals for this research, the creation of a baseline map of the accessible areas of the 3rd Terrace was a success. Several potential areas for future excavation have been identified based upon the combination of the magnetometer and shovel test surveys. Complementary geophysical survey, particularly in areas that were ineffectively surveyed by magnetometer due to high levels of metallic and magnetic disturbance, should be conducted using either electrical resistivity or ground penetrating radar. Additionally, the association between Angel Mounds and Mound G remains tentative, though not disproven by any means. Additional shovel test survey in the vicinity of Mound G, including forested areas to the north, remains a potential avenue to further define the relationship between these two areas of the site.

Ultimately, while there is no definitive evidence for a specific use of the space on the 3rd Terrace, multiple lines of evidence converge on the interpretation that the Mississippian peoples of Angel Mounds utilized the area in the immediate vicinity of the 1939 excavations. This includes a contemporaneous radiocarbon date, variability in material culture morphology such as closed handle ceramics potentially related to an extended temporal depth, and potential Mississippian features based upon the geophysical magnetic and shovel test surveys. It remains to be seen what the nature of this space was and to what extent it was utilized by Mississippian peoples.

As an exercise in conjecture, one possibility for a Mississippian utilization of the 3rd Terrace is for agriculture. As a matter of practicality and food security, it would have beneficial for Mississippian peoples to plant crops both in the floodplain (the 2nd Terrace) and upon higher ground (the 3rd Terrace). This would allow for the assurance of a harvest in both years of flooding (with a protected crop on the higher 3rd Terrace) and drought (with a crop on the more naturally irrigated 2nd Terrace). If this is the case, and the 3rd Terrace were utilized for intensive agriculture, any significant cultural modifications of the landscape would necessarily by on the terrace edges, allowing for maximum use of the land for crops. This is the apparent pattern that is revealed by the magnetic survey, with likely and potential anomalies located along the terrace edge. While more investigation is required to support the theory, perhaps these features on the landscape defined through this research may relate to Mississippian agricultural practices, if in fact they are determined to be of Mississippian origin. While beginning to answer questions regarding the presence of Mississippian people on the 3rd Terrace, this research opens new lines of inquiry about the nature and extent of the utilization of the space. Additionally, questions regarding the wider Mississippian world and the utilization of landscapes surrounding Mississippian centers are relevant to the potential research that may be conducted on the 3rd Terrace in the future. It is my hope that this research will provide a solid basis for future investigations of this area and others that fall beyond the palisade.

Appendices

7.1 – 2011 Shovel Test Survey

Northing	2244	2259	2274	2289	2304	2319
Easting	2411	2411	2411	2411	2411	2411
Material_Culture	no	no	no	no	no	no
Artifacts_Pre-Contact						
Artifacts_Historic						
Artifacts_Feature						
Charcoal						
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4
Depth_cmBS_1	0-7	0-25	0-5	0-10	0-20	0-10
Texture_1	Sa Lo	Si Lo	Sa Lo	Sa Lo	Sa Lo	Sa Lo
Soil_Horizon_2	BE	B	BE	BE	B	B
Munsell_2	10YR 5/4	10YR 5/6	10YR 5/4	10YR 5/4	10YR 5/6	10YR 5/6
Depth_cmBS_2	7-13	25-30	5-20	10-22	20-30	10-30
Texture_2	Si Lo	Sa Lo	Si Lo	Si Lo	Si Lo	
Soil_Horizon_3	B		B	B		
Munsell_3	10YR 5/6		10YR 5/6	10YR 5/6		
Depth_cmBS_3	13-30		20-30	22-30		
Texture_3	Si Lo		Si Lo	Si Lo		
Soil_Horizon_4						
Munsell_4						
Depth_cmBS_4						
Texture_4						
Soil_Horizon_5						
Munsell_5						
Depth_cmBS_5						
Texture_5						
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo						
Comments						
Excavators	MDP, DB	MDP, DB	MDP, DB	MDP, DB	MDP, DB	MDP, DB
Date	6/14/2011	6/14/2011	6/14/2011	6/14/2011	6/14/2011	6/14/2011

Northing	2334	2349	2244	2259	2274	2289
Easting	2411	2411	2426	2426	2426	2426
Material_Culture	no	no	no	no	no	no
Artifacts_Pre-Contact						
Artifacts_Historic						
Artifacts_Feature						
Charcoal						
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4
Depth_cmBS_1	0-18	0-10	0-5	0-9	0-7	0-8
Texture_1	Sa Lo	Sa Lo	Sa Lo	Sa Lo	Sa Lo	Sa Lo
Soil_Horizon_2	?	B	BE	B	BE	BE
Munsell_2	10YR 4/4 w/ 10YR 7/2 layering	10YR 5/6	10YR 5/4	10YR 5/6	10YR 4/4	10YR 4/4
Depth_cmBS_2	18-23	10-30	6-12	10-30	7-23	9-26
Texture_2	Si Lo	Si Lo	Sa Lo	Si Lo	Sa Lo	Sa Lo
Soil_Horizon_3	B		B		B	B
Munsell_3	10YR 5/6		10YR 5/6		10YR 5/4	10YR 5/4
Depth_cmBS_3	23-30		12-30		24-31	26-30
Texture_3	Si Lo		Si Lo		Si Lo	Si Lo
Soil_Horizon_4						
Munsell_4						
Depth_cmBS_4						
Texture_4						
Soil_Horizon_5						
Munsell_5						
Depth_cmBS_5						
Texture_5						
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo						
Comments	10YR 7/2 variably layered in roughly 3-4 mm layers throughout layer 2 along western edge of profile					
Excavators	MDP, DB	MDP, DB	KL, VG	KL, VG	KL, VG	KL, VG
Date	6/14/2011	6/14/2011	6/14/2011	6/14/2011	6/14/2011	6/14/2011

Northing	2304	2319	2334	2349	2244	2259
Easting	2426	2426	2426	2426	2441	2441
Material_Culture	no	no	no	no	no	no
Artifacts_Pre-Contact						
Artifacts_Historic						
Artifacts_Feature						
Charcoal					yes	
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4
Depth_cmBS_1	0-7	0-38	0-11	0-50	0-9	0-6
Texture_1	Sa Lo	Sa Lo	Sa Lo	Si Lo	Sa Lo	Sa Lo
Soil_Horizon_2	BE	B	B		BE	BE
Munsell_2	10YR 4/4	10YR 5/4	10YR 5/4		10YR 5/4 w/ charcoal	10YR 5/4
Depth_cmBS_2	8-29	39-44	12-30		9-26	6-22
Texture_2	Sa Lo	Si Lo	Si Lo		Si Lo	Si Lo
Soil_Horizon_3	B				B	B
Munsell_3	10YR 5/4				10YR 5/6	10YR 6/2 w/ slight 10YR 5/4 mottling
Depth_cmBS_3	30-35				26-30	22-30
Texture_3	Si Lo				Si Lo	Si Cl Lo
Soil_Horizon_4						
Munsell_4						
Depth_cmBS_4						
Texture_4						
Soil_Horizon_5						
Munsell_5						
Depth_cmBS_5						
Texture_5						
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo					yes	yes
Comments					Light charcoal flecking in BE layer	
Excavators	KL, VG	KL, VG	KL, VG	KL, VG	MDP, DB	MDP, DB
Date	6/14/2011	6/14/2011	6/14/2011	6/14/2011	6/14/2011	6/14/2011

Northing	2274	2289	2304	2319	2334	2349
Easting	2441	2441	2441	2441	2441	2441
Material_Culture	no	no	no	no	no	no
Artifacts_Pre-Contact						
Artifacts_Historic						
Artifacts_Feature						
Charcoal		yes				
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/3	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 5/4
Depth_cmBS_1	0-7	0-10	0-9	0-9	0-10	0-9
Texture_1	Sa Lo	Sa Lo	Sa Lo	Sa Lo	Sa Lo	Sa Lo
Soil_Horizon_2	BE	BE	BE	B	B	B
Munsell_2	10YR 5/4 w/ slight 10YR 6/4 mottling	10YR 5/4	10YR 5/4	10YR 5/4	10YR 5/6	10YR 5/6
Depth_cmBS_2	7-21	10-20	9-19	9-30	10-30	9-25
Texture_2	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_3	B	B	B			
Munsell_3	10YR 6/4 w/ 10YR 5/2 mottling	10YR 5/4 w/ 10YR 7/6 mottling	10YR 5/4 w/ 10YR 7/6 mottling			
Depth_cmBS_3	21-30	20-30	19-30			
Texture_3	Si Cl Lo	Si Lo	Si Lo			
Soil_Horizon_4						
Munsell_4						
Depth_cmBS_4						
Texture_4						
Soil_Horizon_5						
Munsell_5						
Depth_cmBS_5						
Texture_5						
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo						
Comments		Small amount of charcoal flecking @ 24 cmBS				Impenetrable below 25 cmBS due to tree roots
Excavators	MDP, DB	MDP, DB	MDP, DB	MDP, DB	MDP, DB	MDP, DB
Date	6/14/2011	6/14/2011	6/14/2011	6/14/2011	6/14/2011	6/14/2011

Northing	2244	2259	2274	2289	2304	2319
Easting	2456	2456	2456	2456	2456	2456
Material_Culture	no	no	no	no	no	no
Artifacts_Pre-Contact						
Artifacts_Historic						
Artifacts_Feature						
Charcoal		yes				
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4
Depth_cmBS_1	0-30	0-15	0-15	0-20	0-13	0-14
Texture_1	Si Lo	Sa Lo	Sa Lo	Sa Lo	Sa Lo	Sa Lo
Soil_Horizon_2	B	BE	BE	BE	BE	BE
Munsell_2	10YR 5/6	10YR 5/6	10YR 5/4	10YR 5/4	10YR 5/4	10YR 5/4
Depth_cmBS_2	30-40	15-25	15-25	20-30	13-28	14-29
Texture_2	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_3		B	B	B	B	B
Munsell_3		10YR 5/4 w/ 10YR 5/6 mottling and 5% charcoal flecking	10YR 5/6	10YR 5/6	10YR 5/6	10YR 5/6
Depth_cmBS_3		25-35	25-35	30-40	28-38	29-39
Texture_3		Si Lo	Si Lo	Si Cl Lo	Si Lo	Si Lo
Soil_Horizon_4						
Munsell_4						
Depth_cmBS_4						
Texture_4						
Soil_Horizon_5						
Munsell_5						
Depth_cmBS_5						
Texture_5						
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo						
Comments		5% charcoal flecking in B horizon				
Excavators	MDP, EB	MDP, EB	MDP, EB	MDP, EB	MDP, EB	MDP, EB
Date	6/15/2011	6/15/2011	6/15/2011	6/15/2011	6/15/2011	6/15/2011

Northing	2334	2349	1929	1944	1959	1964
Easting	2456	2456	2561	2561	2561	2561
Material_Culture	no	no	no	yes	yes	yes
Artifacts_Pre-Contact						
Artifacts_Historic				Brick fragments - not collected	8 - 7 glass, 1 nail	4 - 4 glass
Artifacts_Feature						
Charcoal						
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4
Depth_cmBS_1	0-8	0-7	0-8	0-12	0-13	0-11
Texture_1	Sa Lo	Sa Lo	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_2	B	B	BE	BE	BE	BE
Munsell_2	10YR 5/4	10YR 5/4	10YR 4/4 w/ 10% 10YR 5/6 mottling	10YR 4/4 w/ 10YR 5/6 mottling	10YR 4/4	10YR 5/4
Depth_cmBS_2	8-38	7-24	8-19	12-23	13-23	11-19
Texture_2	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_3	BC	BC	B	B	B	B
Munsell_3	10YR 5/6	10YR 5/6	10YR 5/6	10YR 5/6	10YR 5/6	10YR 5/6
Depth_cmBS_3	38-50	24-30	19-30	23-30	23-30	19-30
Texture_3	Si Lo	Si Cl Lo	Si Cl Lo	Si Lo	Si Cl Lo	Si Cl Lo
Soil_Horizon_4						
Munsell_4						
Depth_cmBS_4						
Texture_4						
Soil_Horizon_5						
Munsell_5						
Depth_cmBS_5						
Texture_5						
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo						
Comments				foil wrapper trash present, brick fragments present - not collected	foil wrapper trash present	
Excavators	MDP, EB	MDP, EB	MDP, LC	MDP, LC	MDP, LC	MDP
Date	6/15/2011	6/15/2011	6/20/2011	6/20/2011	6/20/2011	6/20/2011

Northing	1969	1974	1979	1984	1989	1994
Easting	2561	2561	2561	2561	2561	2561
Material_Culture	yes	yes	no	no	yes	no
Artifacts_Pre-Contact						
Artifacts_Historic	3 - 1 nail, 2 glass	1 - 1 glass			11 - 10 nails, 1 clear glass	
Artifacts_Feature					yes	
Charcoal		yes			yes	
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/3	10YR 4/4
Depth_cmBS_1	0-7	0-10	0-9	0-9	0-12	0-9
Texture_1	Si Lo	Si Lo	Si Lo	Si Lo	Si Cl Lo	Si Lo
Soil_Horizon_2	BE	BE	BE	BE	charcoal lens	BE
Munsell_2	10YR 4/4	10YR 4/4 w/ 25% 10YR 5/6 mottling	10YR 4/4	10YR 4/4		10YR 4/4
Depth_cmBS_2	7-20	10-30	9-27	9-22	12-14	9-19
Texture_2	Si Cl Lo	Si Lo	Si Cl Lo	Si Cl Lo		Si Cl Lo
Soil_Horizon_3	B		B	B	BE	B
Munsell_3	10YR 5/6		10YR 5/6	10YR 5/4	10YR 4/3 w/ 50% 10YR 5/6 mottling	10YR 5/6
Depth_cmBS_3	20-30		27-37	22-30	14-21	19-30
Texture_3	Si Cl Lo		Si Cl Lo	Si Cl Lo	Si Cl Lo	Si Cl Lo
Soil_Horizon_4					B	
Munsell_4					10YR 5/6 w/ 5% 10YR 4/3 mottle	
Depth_cmBS_4					21-30	
Texture_4					Si Cl Lo	
Soil_Horizon_5						
Munsell_5						
Depth_cmBS_5						
Texture_5						
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo						
Comments		Charcoal flecking present			Charcoal lens present in southern 1/2 of STP from 12-14 cmBS, likely historic or modern feature	
Excavators	MDP	MDP, LC	MDP	MDP	MDP, LC	MDP
Date	6/20/2011	6/20/2011	6/20/2011	6/20/2011	6/20/2011	6/20/2011

Northing	1999	2004	1969	1974	1979	1984
Easting	2561	2561	2566	2566	2566	2566
Material_Culture	no	no	yes	no	no	no
Artifacts_Pre-Contact						
Artifacts_Historic			Fire slag - not collected			
Artifacts_Feature						
Charcoal						
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4
Depth_cmBS_1	0-8	0-10	0-10	0-9	0-6	0-8
Texture_1	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_2	BE	BE	BE	BE	BE	BE
Munsell_2	10YR 5/4	10YR 4/4 w/ 5% 10YR 5/6 mottling	10YR 5/4	10YR 5/4	10YR 5/4	10YR 5/4
Depth_cmBS_2	8-16	10-20	10-19	9-19	6-17	8-18
Texture_2	Si Cl Lo	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_3	B	B	B	B	B	B
Munsell_3	10YR 5/6	10YR 5/6	10YR 5/6	10YR 5/6	10YR 5/6	10YR 5/6
Depth_cmBS_3	16-30	20-30	19-30	19-30	17-30	18-30
Texture_3	Si Cl Lo	Si Cl Lo	Si Cl Lo	Si Cl Lo	Si Cl Lo	Si Cl Lo
Soil_Horizon_4						
Munsell_4						
Depth_cmBS_4						
Texture_4						
Soil_Horizon_5						
Munsell_5						
Depth_cmBS_5						
Texture_5						
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo		yes				
Comments			Fire slag present - not collected			
Excavators	MDP	MDP, LC	MDP	MDP	MDP	MDP
Date	6/20/2011	6/20/2011	6/20/2011	6/20/2011	6/20/2011	6/20/2011

Northing	1989	1994	1999	1969	1974	1979
Easting	2566	2566	2566	2571	2571	2571
Material_Culture	no	no	no	no	no	yes
Artifacts_Pre-Contact						
Artifacts_Historic						
Artifacts_Feature						yes
Charcoal						
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4
Depth_cmBS_1	0-5	0-8	0-14	0-9	0-9	0-10
Texture_1	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_2	BE	BE	BE	BE	BE	B
Munsell_2	10YR 5/4	10YR 5/4	10YR 5/4	10YR 5/4	10YR 5/4	10YR 5/6
Depth_cmBS_2	5-17	8-17	14-22	9-22	9-35	10-47
Texture_2	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo	Si Cl Lo
Soil_Horizon_3	B	B	B	B	B	?
Munsell_3	10YR 5/6	10YR 5/6	10YR 5/6	10YR 5/6	10YR 5/6	10YR 4/4
Depth_cmBS_3	17-30	17-30	22-30	22-30	35-45	47-60
Texture_3	Si Cl Lo	Si Cl Lo	Si Cl Lo	Si Cl Lo	Si Cl Lo	Si Lo
Soil_Horizon_4						
Munsell_4						
Depth_cmBS_4						
Texture_4						
Soil_Horizon_5						
Munsell_5						
Depth_cmBS_5						
Texture_5						
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo						
Comments					particularly deep BE horizon	Possibly a buried A Horizon in Level 3
Excavators	MDP	MDP	MDP	MDP	MDP, AO	MDP, AO
Date	6/20/2011	6/20/2011	6/20/2011	6/20/2011	6/21/2011	6/21/2011

Northing	1984	1989	1994	1999	1929	1944
Easting	2571	2571	2571	2571	2576	2576
Material_Culture	yes	yes	no	no	no	no
Artifacts_Pre-Contact						
Artifacts_Historic						
Artifacts_Feature	yes	yes				
Charcoal		yes				yes
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4
Depth_cmBS_1	0-10	0-12	0-9	0-9	0-15	0-10
Texture_1	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_2	BE	BE	BE	BE	BE	BE
Munsell_2	10YR 4/6	10YR 5/6	10YR 5/4	10YR 5/4	Mottled 10YR 4/4 & 10YR 5/6	10YR 4/4 w/ 5% 10YR 5/6 mottling
Depth_cmBS_2	10-41	12-40	9-30	9-19	15-30	10-25
Texture_2	Si Lo	Si Lo, w/ charcoal	Si Lo	Si Lo	Si Cl Lo	Si Cl Lo
Soil_Horizon_3	?	?	B	B		B
Munsell_3	10YR 4/3 w/ 10% 10YR 5/6 mottling	10YR 5/6 w/ 10YR 4/4 & 10YR 6/6 mottling	10YR 5/6	10YR 5/6		10YR 5/6
Depth_cmBS_3	41-50	40-47	30-40	19-30		25-30
Texture_3	Si Lo	Sa Lo	Si Lo	Si Cl Lo		Si Cl Lo
Soil_Horizon_4	B	?				
Munsell_4	10YR 5/6	10YR 4/4 w/ 10YR 5/6 mottling				
Depth_cmBS_4	50-60	47-59				
Texture_4	Si Lo	Si Lo				
Soil_Horizon_5		?				
Munsell_5		10YR 4/3 w/ 10YR 5/6 mottling				
Depth_cmBS_5		59-71				
Texture_5		Si Lo				
Soil_Horizon_6		?				
Munsell_6		10YR 4/4 w/ 10YR 5/3 & 10YR 6/6 mottling				
Depth_cmBS_6		71-80				
Texture_6		Si Lo				
Photo						
Comments	Level 3 is a possible feature	Possible feature present in layers 2-6, charcoal present in layer 2				charcoal present
Excavators	MDP, AO	MDP, AO	MDP, AO	MDP, AO	MDP, LC	MDP, LC
Date	6/21/2011	6/21/2011	6/21/2011	6/21/2011	6/20/2011	6/20/2011

Northing	1959	1969	1974	1979	1984	1989
Easting	2576	2576	2576	2576	2576	2576
Material_Culture	yes	no	no	yes	yes	no
Artifacts_Pre-Contact	1 flake					
Artifacts_Historic						
Artifacts_Feature				yes	yes	
Charcoal				yes		
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4
Depth_cmBS_1	0-10	0-8	0-9	0-10	0-9	0-11
Texture_1	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo	Si lo
Soil_Horizon_2	BE	BE	BE	BE	BE	BE
Munsell_2	10YR 5/6 w/ 25% 10YR 4/4 mottling	10YR 5/4	10YR 5/6	10YR 5/4	10YR 5/4	10YR 4/4 w/ 10% 10yr 5/6 mottling
Depth_cmBS_2	10-20	8-18	9-20	10-37	9-33	11-19
Texture_2	Si Lo	Si Lo	Si Lo	Si Lo	Si Cl Lo	Si Lo
Soil_Horizon_3	B	B	B	B	?	B
Munsell_3	10YR 5/6	10YR 5/6	10YR 4/6	10YR 4/4 w/ charcoal	10YR 5/4 w/ 10YR 5/6 & 10YR 4/3 mottling	10YR 5/6
Depth_cmBS_3	20-30	18-30	20-30	37-62	33-45	19-30
Texture_3	Si Cl Lo	Si Cl Lo	Si Cl Lo	Si Cl Lo	Si Lo	Si Cl Lo
Soil_Horizon_4				C	B	
Munsell_4				10YR 5/3 w/ 10YR 4/6 mottling	10YR 5/6	
Depth_cmBS_4				62-70	45-55	
Texture_4				Hydric Clay	Si Cl Lo	
Soil_Horizon_5						
Munsell_5						
Depth_cmBS_5						
Texture_5						
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo						
Comments				Charcoal and possible feature present in level 3	Possible feature in level 3	
Excavators	MDP, LC	MDP, AO	MDP, LC	MDP, AO	MDP, TR	MDP, LC
Date	6/20/2011	6/21/2011	6/20/2011	6/21/2011	6/21/2011	6/20/2011

Northing	1994	1999	2004	1969	1974	1979
Easting	2576	2576	2576	2581	2581	2581
Material_Culture	yes	no	no	no	no	no
Artifacts_Pre-Contact						
Artifacts_Historic						
Artifacts_Feature	yes					
Charcoal						
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4
Depth_cmBS_1	0-10	0-8	0-10	0-10	0-10	0-10
Texture_1	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_2	BE	BE	BE	BE	BE	BE
Munsell_2	10YR 5/4	10YR 5/4	10YR 4/4 w/ 5% 10YR 5/6 mottling	10YR 5/4	10YR 5/4	10YR 5/4
Depth_cmBS_2	10-36	8-19	10-17	10-20	10-19	10-20
Texture_2	Si Lo	Si Lo	Si Cl Lo	Si Lo	Si Lo	Sa Lo
Soil_Horizon_3	?	B	B	B	B	B
Munsell_3	10YR 4/4 w/ 10YR 5/6 mottling	10YR 5/6	10YR 5/6	10YR 5/6	10YR 5/6	10YR 5/6
Depth_cmBS_3	36-50	19-30	17-30	20-30	19-30	20-30
Texture_3	Si Lo	Si Cl Lo	Si Cl Lo	Si Cl Lo	Si Cl Lo	Sa Cl Lo
Soil_Horizon_4	B					
Munsell_4	10YR 5/6					
Depth_cmBS_4	50-60					
Texture_4	Si Cl Lo					
Soil_Horizon_5						
Munsell_5						
Depth_cmBS_5						
Texture_5						
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo						
Comments	Possible feature in level 3					
Excavators	MDP, TR	MDP, TR	MDP, LC	MDP	MDP, TR	MDP, TR
Date	6/21/2011	6/21/2011	6/20/2011	6/22/2011	6/21/2011	6/21/2011

Northing	1984	1989	1994	1999	1969	1974
Easting	2581	2581	2581	2581	2586	2586
Material_Culture	no	no	yes	no	no	yes
Artifacts_Pre-Contact						
Artifacts_Historic						
Artifacts_Feature			yes			yes
Charcoal			yes			yes
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4
Depth_cmBS_1	0-8	0-8	0-10	0-7	0-7	0-9
Texture_1	Si Lo	Sa Lo	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_2	BE	BE	BE	BE	BE	BE
Munsell_2	10YR 5/4	10YR 5/4	10YR 5/4	10YR 5/4	10YR 5/4	10YR 5/4
Depth_cmBS_2	8-16	8-30	10-34	7-20	7-20	9-19
Texture_2	Si Lo	Sa Lo	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_3	B	B	?	B	B	?
Munsell_3	10YR 5/6	10YR 5/6	10YR 4/3 w/ charcoal	10YR 5/6 w/ 10YR 6/2 mottling	10YR 5/6	10YR 5/4 w/ 10YR 5/6 mottling and 5% charcoal flecking
Depth_cmBS_3	16-30	30-40	34-52	20-30	20-30	19-25
Texture_3	Si Cl Lo	Sa Cl Lo	Si Lo	Si Cl Lo	Si Cl Lo	Si Lo
Soil_Horizon_4			B			BE
Munsell_4			10YR 5/6			10YR 5/4
Depth_cmBS_4			52-60			25-30
Texture_4			Si Cl Lo			Si Lo
Soil_Horizon_5						B
Munsell_5						10YR 5/6
Depth_cmBS_5						30-40
Texture_5						Si Cl Lo
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo						
Comments			Possible feature in level 3			Charcoal and possible feature present in level 3
Excavators	MDP, TR	MDP, TR	MDP, TR	MDP, TR	MDP	MDP
Date	6/21/2011	6/21/2011	6/21/2011	6/21/2011	6/22/2011	6/22/2011

Northing	1979	1984	1989	1994	1999	2244
Easting	2586	2586	2586	2586	2586	2471
Material_Culture	no	no	no	yes	no	no
Artifacts_Pre-Contact				1 heated lithic flake		
Artifacts_Historic						
Artifacts_Feature						
Charcoal						
Soil_Horizon_1	A	A	A	A	A	
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	
Depth_cmBS_1	0-10	0-9	0-12	0-12	0-11	
Texture_1	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo	
Soil_Horizon_2	BE	BE	BE	BE	BE	
Munsell_2	10YR 5/4	10YR 5/4	10YR 5/4	10YR 5/4	10YR 5/4	
Depth_cmBS_2	10-25	9-28	12-35	12-30	11-23	
Texture_2	Si lo	Si Lo	Si Lo	Si Lo	Si Lo	
Soil_Horizon_3	B	B	B	B	B	
Munsell_3	10YR 5/6	10YR 5/6 w/ 10% 10YR 6/3 mottling	10YR 5/6 w/ 10YR 6/3 mottling	10YR 5/6 w/ 10YR 6/3 mottling	10YR 5/6	
Depth_cmBS_3	25-35	28-60	35-45	30-40	23-33	
Texture_3	Si Cl Lo	Si Cl Lo	Si Cl Lo	Si Cl Lo	Si Cl Lo	
Soil_Horizon_4						
Munsell_4						
Depth_cmBS_4						
Texture_4						
Soil_Horizon_5						
Munsell_5						
Depth_cmBS_5						
Texture_5						
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo						
Comments	Large concentration of burnt shale and fire slag @ 8 cmBS	B Horizon excavated deep to determine if 10YR 4/3 layer in STPs to the west was present here				
Excavators	MDP	MDP	MDP	MDP	MDP	KL, VG
Date	6/22/2011	6/22/2011	6/22/2011	6/22/2011	6/22/2011	

Northing	2259	2274	2289	2304	2319	2334
Easting	2471	2471	2471	2471	2471	2471
Material_Culture	no	no	no	no	no	no
Artifacts_Pre-Contact						
Artifacts_Historic						
Artifacts_Feature						
Charcoal						
Soil_Horizon_1						
Munsell_1						
Depth_cmBS_1						
Texture_1						
Soil_Horizon_2						
Munsell_2						
Depth_cmBS_2						
Texture_2						
Soil_Horizon_3						
Munsell_3						
Depth_cmBS_3						
Texture_3						
Soil_Horizon_4						
Munsell_4						
Depth_cmBS_4						
Texture_4						
Soil_Horizon_5						
Munsell_5						
Depth_cmBS_5						
Texture_5						
Soil_Horizon_6						
Munsell_6						
Depth_cmBS_6						
Texture_6						
Photo						
Comments						
Excavators	KL, VG	KL, VG	KL, VG	KL, VG	KL, VG	KL, VG
Date						

Northing	2349
Easting	2471
Material_Culture	no
Artifacts_Pre-Contact	
Artifacts_Historic	
Artifacts_Feature	
Charcoal	
Soil_Horizon_1	
Munsell_1	
Depth_cmBS_1	
Texture_1	
Soil_Horizon_2	
Munsell_2	
Depth_cmBS_2	
Texture_2	
Soil_Horizon_3	
Munsell_3	
Depth_cmBS_3	
Texture_3	
Soil_Horizon_4	
Munsell_4	
Depth_cmBS_4	
Texture_4	
Soil_Horizon_5	
Munsell_5	
Depth_cmBS_5	
Texture_5	
Soil_Horizon_6	
Munsell_6	
Depth_cmBS_6	
Texture_6	
Photo	
Comments	
Excavators	KL, VG
Date	

7.2 – 2011 Positive Shovel Tests

Northing	1979	1984	1989	1959	1979	1984
Easting	2571	2571	2571	2576	2576	2576
Material_Culture	yes	yes	yes	yes	yes	yes
Artifacts_Pre-Contact				1 flake		
Artifacts_Historic						
Artifacts_Feature	yes	yes	yes		yes	yes
Charcoal			yes		yes	
Soil_Horizon_1	A	A	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4
Depth_cmBS_1	0-10	0-10	0-12	0-10	0-10	0-9
Texture_1	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_2	B	BE	BE	BE	BE	BE
Munsell_2	10YR 5/6	10YR 4/6	10YR 5/6	10YR 5/6 w/ 25% 10YR 4/4 mottling	10YR 5/4	10YR 5/4
Depth_cmBS_2	10-47	10-41	12-40	10-20	10-37	9-33
Texture_2	Si Cl Lo	Si Lo	Si Lo, w/ charcoal	Si Lo	Si Lo	Si Cl Lo
Soil_Horizon_3	?	?	?	B	B	?
Munsell_3	10YR 4/4	10YR 4/3 w/ 10% 10YR 5/6 mottling	10YR 5/6 w/ 10YR 4/4 & 10YR 6/6 mottling	10YR 5/6	10YR 4/4 w/ charcoal	10YR 5/4 w/ 10YR 5/6 & 10YR 4/3 mottling
Depth_cmBS_3	47-60	41-50	40-47	20-30	37-62	33-45
Texture_3	Si Lo	Si Lo	Sa Lo	Si Cl Lo	Si Cl Lo	Si Lo
Soil_Horizon_4		B	?		C	B
Munsell_4		10YR 5/6	10YR 4/4 w/ 10YR 5/6 mottling		10YR 5/3 w/ 10YR 4/6 mottling	10YR 5/6
Depth_cmBS_4		50-60	47-59		62-70	45-55
Texture_4		Si Lo	Si Lo		Hydric Clay	Si Cl Lo
Soil_Horizon_5			?			
Munsell_5			10YR 4/3 w/ 10YR 5/6 mottling			
Depth_cmBS_5			59-71			
Texture_5			Si Lo			
Soil_Horizon_6			?			
Munsell_6			10YR 4/4 w/ 10YR 5/3 & 10YR 6/6 mottling			
Depth_cmBS_6			71-80			
Texture_6			Si Lo			
Photo						
Comments	Possibly a buried A Horizon in Level 3	Level 3 is a possible feature	Possible feature present in layers 2-6, charcoal present in layer 2		Charcoal and possible feature present in level 3	Possible feature in level 3
Excavators	MDP, AO	MDP, AO	MDP, AO	MDP, LC	MDP, AO	MDP, TR
Date	6/21/2011	6/21/2011	6/21/2011	6/20/2011	6/21/2011	6/21/2011

Northing	1994	1994	1974	1994
Easting	2576	2581	2586	2586
Material_Culture	yes	yes	yes	yes
Artifacts_Pre-Contact				1 heated lithic flake
Artifacts_Historic				
Artifacts_Feature	yes	yes	yes	
Charcoal		yes	yes	
Soil_Horizon_1	A	A	A	A
Munsell_1	10YR 4/4	10YR 4/4	10YR 4/4	10YR 4/4
Depth_cmBS_1	0-10	0-10	0-9	0-12
Texture_1	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_2	BE	BE	BE	BE
Munsell_2	10YR 5/4	10YR 5/4	10YR 5/4	10YR 5/4
Depth_cmBS_2	10-36	10-34	9-19	12-30
Texture_2	Si Lo	Si Lo	Si Lo	Si Lo
Soil_Horizon_3	?	?	?	B
Munsell_3	10YR 4/4 w/ 10YR 5/6 mottling	10YR 4/3 w/ charcoal	10YR 5/4 w/ 10YR 5/6 mottling and 5% charcoal flecking	10YR 5/6 w/ 10YR 6/3 mottling
Depth_cmBS_3	36-50	34-52	19-25	30-40
Texture_3	Si Lo	Si Lo	Si Lo	Si Cl Lo
Soil_Horizon_4	B	B	BE	
Munsell_4	10YR 5/6	10YR 5/6	10YR 5/4	
Depth_cmBS_4	50-60	52-60	25-30	
Texture_4	Si Cl Lo	Si Cl Lo	Si Lo	
Soil_Horizon_5			B	
Munsell_5			10YR 5/6	
Depth_cmBS_5			30-40	
Texture_5			Si Cl Lo	
Soil_Horizon_6				
Munsell_6				
Depth_cmBS_6				
Texture_6				
Photo				
Comments	Possible feature in level 3	Possible feature in level 3	Charcoal and possible feature present in level 3	
Excavators	MDP, TR	MDP, TR	MDP	MDP
Date	6/21/2011	6/21/2011	6/22/2011	6/22/2011

7.3 – ANOVA – Mean Orifice Diameter, Split Vessel Type

VesselID = 1

ANOVA[a]

Diameter

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3336.044	3	1112.015	1.037	.375
Within Groups	1368602.706	1276	1072.573		
Total	1371938.750	1279			

a. VesselID = 1

Post Hoc Tests

Multiple Comparisons[a]

Diameter
Scheffe

					95% Confidence Interval	
(I) AreaID	(J) AreaID	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
1	2	1.469	4.512	.991	-11.16	14.10
	3	3.569	2.429	.540	-3.23	10.37
	4	-10.502	14.810	.918	-51.96	30.95
2	1	-1.469	4.512	.991	-14.10	11.16
	3	2.100	4.079	.966	-9.32	13.52
	4	-11.971	15.168	.891	-54.43	30.49
3	1	-3.569	2.429	.540	-10.37	3.23
	2	-2.100	4.079	.966	-13.52	9.32
	4	-14.071	14.684	.821	-55.17	27.03
4	1	10.502	14.810	.918	-30.95	51.96
	2	11.971	15.168	.891	-30.49	54.43
	3	14.071	14.684	.821	-27.03	55.17

a. VesselID = 1

Homogeneous Subsets

Diameter[c]

Scheffe[a,b]

AreaID	N	Subset for alpha = 0.05
		1
3	983	319.93
2	69	322.03
1	223	323.50
4	5	334.00
Sig.		.642

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 18.182.
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.
c. VesselID = 1

VesselID = 2

ANOVA[a]

Diameter

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	13863.622	3	4621.207	.614	.606
Within Groups	5634002.930	749	7522.033		
Total	5647866.552	752			

a. VesselID = 2

Post Hoc Tests

Multiple Comparisons[a]

Diameter
Scheffe

(I) AreaID	(J) AreaID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	18.800	44.053	.980	-104.63	142.23
	3	-1.102	8.521	.999	-24.98	22.77
	4	-26.463	21.356	.674	-86.30	33.37
2	1	-18.800	44.053	.980	-142.23	104.63
	3	-19.902	43.508	.976	-141.81	102.00
	4	-45.263	47.712	.825	-178.94	88.42
3	1	1.102	8.521	.999	-22.77	24.98
	2	19.902	43.508	.976	-102.00	141.81
	4	-25.361	20.207	.665	-81.98	31.26
4	1	26.463	21.356	.674	-33.37	86.30
	2	45.263	47.712	.825	-88.42	178.94
	3	25.361	20.207	.665	-31.26	81.98

a. VesselID = 2

Homogeneous Subsets

Diameter[c]

Scheffe[a,b]

AreaID	N	Subset for alpha = 0.05
		1
2	4	205.00
1	125	223.80
3	605	224.90
4	19	250.26
Sig.		.627

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 12.809.
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.
c. VesselID = 2

VesselID = 3

ANOVA[a]

Diameter

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	27631.660	3	9210.553	1.841	.139
Within Groups	2106728.095	421	5004.105		
Total	2134359.755	424			

a. VesselID = 3

Post Hoc Tests

Multiple Comparisons[a]

Diameter
Scheffe

(I) AreaID	(J) AreaID	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	24.328	26.679	.842	-50.56	99.21
	3	-11.483	10.021	.726	-39.61	16.64
	4	39.828	32.971	.692	-52.72	132.37
2	1	-24.328	26.679	.842	-99.21	50.56
	3	-35.811	25.291	.572	-106.80	35.18
	4	15.500	40.328	.986	-97.69	128.69
3	1	11.483	10.021	.726	-16.64	39.61
	2	35.811	25.291	.572	-35.18	106.80
	4	51.311	31.858	.459	-38.11	140.73
4	1	-39.828	32.971	.692	-132.37	52.72
	2	-15.500	40.328	.986	-128.69	97.69
	3	-51.311	31.858	.459	-140.73	38.11

a. VesselID = 3

Homogeneous Subsets

Diameter[c]

Scheffe[a,b]

AreaID	N	Subset for alpha = 0.05
		1
4	5	152.00
2	8	167.50
1	58	191.83
3	354	203.31
Sig.		.385

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 11.592.
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.
c. VesselID = 3

7.4 – Chi-Square of Vessel Type, Four Angel Mounds Areas

Chi-Square Test

Frequencies

VesselID

Area		Observed N	Expected N	Residual
3rd Terrace	1	5	6.8	-1.8
	2	19	6.8	12.2
	3	5	6.8	-1.8
	4	4	6.8	-2.8
	5	1	6.8	-5.8
	Total	34		
Angel	1	983	647.3	335.7
	2	605	647.3	-42.3
	3	354	647.3	-293.3
	Total	1942		
Mound F	1	69	27.0	42.0
	2	4	27.0	-23.0
	3	8	27.0	-19.0
	Total	81		
W-10-D	1	223	135.3	87.7
	2	125	135.3	-10.3
	3	58	135.3	-77.3
	Total	406		

Test Statistics

Area		VesselID
3rd Terrace	Chi-Square	28.941[a]
	df	4
	Asymp. Sig.	.000
Angel	Chi-Square	309.746[b]
	df	2
	Asymp. Sig.	.000
Mound F	Chi-Square	98.296[c]
	df	2
	Asymp. Sig.	.000
W-10-D	Chi-Square	101.768[d]
	df	2
	Asymp. Sig.	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.8.
b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 647.3.
c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 27.0.
d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 135.3.

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Education

2012 Master of Arts – Applied Anthropology – Indiana University
2012 Graduate Certificate – Geographic Information Systems – Indiana University
2005 Bachelor of Arts – Anthropology – Indiana University

Honors, Awards, & Fellowships

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- $36,000 and tuition reimbursement for two years

2011 *Glenn A. Black Laboratory of Archaeology Fellowship* – Indiana University
- $12,000 and tuition reimbursement for one year

2010 *University Graduate Fellowship* – Indiana University-Purdue University-Indianapolis
- $12,000 and tuition reimbursement for one year

Professional Organizations

2010-present Midwest Archaeological Conference
2010-present Society for American Archaeology

Research and Training Experience

2012 *Angel Mounds State Historic Site* – Glenn A. Black Laboratory of Archaeology and Indiana University-Purdue University-Indianapolis Field School – Evansville, IN
2012 *German Ridge Heritage Project* – Glenn A. Black Laboratory of Archaeology Field School - Hoosier National Forest – Tell City, IN
2012 *Thomas Jefferson's Monticello* - Department of Archaeology of the Thomas Jefferson Foundation at Monticello – Glenn A. Black Laboratory of Archaeology – Charlottesville, VA
2012 *Mt. Pleasant Indian Boarding School* – Central Michigan University Field School – McCullough Archaeological Services – Mt. Pleasant, MI
2011 *Lawrenz Gun Club* – Indiana University-Purdue University-Indianapolis – Beardstown, IL
2011 *Angel Mounds State Historic Site* – Glenn A. Black Laboratory of Archaeology and Indiana University-Purdue University-Indianapolis Field School –Evansville, IN

Conferences Attended

2012 Midwest Archaeological Conference Annual Meeting – Lansing, MI
- *Shifting Boundaries: Preliminary Geophysical Investigations of the Palisade Walls at Angel Mounds*

2012 Society for American Archaeology Annual Meeting – Memphis, TN
- *Beyond the Palisade: Using geophysical remote sensing techniques to investigate life outside the walls at Angel Mounds*

2011 Mississippian Conference – Angel Mounds State Historic Site – Evansville, IN
- *Beyond the Palisade: Using geophysical remote sensing techniques to investigate life outside the walls at Angel Mounds*

Professional Experience

2010 Archaeological Technician – AMEC Earth and Environmental
- *Dixie Dr. Interchange, UDOT Ph. III mitigation* – UT – Sonia Hutmacker, Principal Investigator; John Hunter, Field Supervisor – 5 weeks

2009 Archaeological Technician – J.M. Waller & Assoc.
- *Camp Atterbury JMTC* – IN – Karsten Carmany-George (IDNR), Cultural Resource Manager – 7 months

2009 Archaeological Technician – ICI Services
- *Fort Knox Survey* – KY – Jim Pritchard (Brockington & Assoc.), Principal Investigator – 2 weeks

2009 Archaeological Technician – Hardlines Design Company
- *Army Corps of Engineers Westhill Dam and Westville Lake Survey* – MA – Andrew Sewell, Principal Investigator – 1 month

2009 Archaeological Technician – AMEC Earth and Environmental
- *Camp Atterbury JMTC Survey* – IN – Heather Childers, Principal Investigator – 2 weeks

2009 Archaeological Technician – AMEC Earth and Environmental
- *West Virginia National Guard Survey* – WV – Wayna Roach, Principal Investigator – 1 week

2009 Archaeological Technician – AMEC Earth and Environmental
- *Arnold Air Force Base Survey* – TN – Mark Wompler, Principal Investigator – 2 months

2009 Archaeological Technician – AMEC Earth and Environmental
- *REX Pipeline* – MO – Ph. III Mitigation – Nathan Scholl, Principal Investigator – 2 months

2008 Temporary Archaeological Technician – Indiana DNR, Indiana State Museum
- *Yankeetown Dig* – IN – Rex Garniewicz, Director – 3 days

2003 Seasonal Archaeological Technician – USDA, National Forest Service

- *Hoosier National Forest* – IN – Angie Krieger, Director – 4 months

2003 Field School Student – Indiana University

- *Chau Hiix Archaeological Project* – Belize – Anne Pyburn, Director – 2 months

Teaching Experience

2007-11 Indiana State Museum (Indiana DNR) – Museum Education Specialist
2006-07 Children's Museum of Indianapolis – Gallery Interpreter
2005 Hudson River Sloop Clearwater – Sailing Apprentice/Educator